International Energy Agency

Co-funded by the European Union

Kazakhstan 2022

Energy Sector Review

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INTERNATIONAL ENERGY AGENCY

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Foreword

The International Energy Agency (IEA) has conducted in-depth peer reviews of its member countries' energy policies since 1976. Since the early 1990s, it has also reviewed the energy policies of selected non-members. The IEA recently modernised these reviews to focus on countries' key energy transition and security issues, helping them play a prominent role in bilateral collaboration between IEA member countries and non-members.

Kazakhstan is one of the focus countries of the EU4Energy programme, which is being implemented by the IEA and the European Union, along with the Energy Community Secretariat and the Energy Charter Secretariat. The EU4Energy programme includes Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. It was designed to support the goals and aspirations of the focus countries to implement sustainable energy policies and foster regional co-operation on energy-sector development. One of the key ways the programme does this is by conducting in-depth policy reviews of individual countries, updating and extending the analysis from the IEA's 2015 regional review, *Energy Policies Beyond IEA Countries: Eastern Europe, Caucasus and Central Asia*.

Kazakhstan has made progress in a number of areas since the 2015 review, including energy statistics and the development of renewables. The government has made ambitious commitments to further increase the role of renewables in electricity supply, as well as to reduce greenhouse gas emissions. However, dependence on large reserves of inexpensive coal and a lack of flexible generating capacity make these a challenge. While oil provides much of the country's export earnings and government revenue, many major oil-importing countries have recently pledged to reduce greenhouse gas emissions, and most exports currently must pass through the Russian Federation. Low domestic energy prices have been a social priority (a rise in prices for liquefied petroleum gas reportedly sparked the unrest that gripped the country in January 2022), but low prices have made it difficult to promote efficiency and to stimulate the exploration and commercial production of gas to meet the government's ambitious gasification goals.

This in-depth review aims to guide Kazakhstan in its energy sector reforms and help it achieve its energy policy goals, including a transition to secure, affordable and less polluting energy for its population.

ENERGY INSIGHTS

ENERGY SECURITY

ENERGY SYSTEM TRANSFORMATION

ANNEXES

LIST OF FIGURES, TABLES AND BOXES

Figures

Tables

Boxes

1. Executive summary

Overview

The Republic of Kazakhstan is the largest of the former Soviet Republics in Central Asia, as well as the region's largest energy producer. It is bordered in the north by the Russian Federation (hereafter, "Russia"), in the east by the People's Republic of China (hereafter, "China"), in the south by Kyrgyzstan and Uzbekistan, and in the west by Turkmenistan and the Caspian Sea. The country has a land area of 2 717 300 square kilometres (km^2), a coastline of 1 894 kilometres (km) on the Caspian Sea, and a population of 18.7 million.

The oil and gas industries and related sectors accounted for 17% of gross domestic product (GDP) in 2020. Oil provides most of the country's export earnings and serves as the main source of government revenue.

Energy supply and demand

Oil accounted for over 50% of Kazakhstan's domestic energy production in 2020. Its second main source of energy production is coal, which accounted for 28%, followed by natural gas (17%).

Kazakhstan's significant overall energy surplus has remained stable over the last two decades, averaging 230% of the energy supply needed to cover domestic demand. This has allowed Kazakhstan to be a large net exporter of fossil fuels, particularly oil.

Almost one-third of total final energy consumption (TFC) in 2020 was covered by oil (31%), followed by coal (22%), while heat, natural gas and electricity each accounted for around 15%. The residential sector consumed 33% of TFC in 2020, surpassing industry (32%) that year as the largest consuming sector. Transport accounted for 18%, while the remainder (16%) was consumed by services and other sectors.

General energy policy

The 2013 Concept for the Transition to a Green Economy (Green Economy Concept) calls for the country to generate 50% of its electricity by 2050 from "alternative or renewable" sources, which could include nuclear. It also calls for a 15% reduction in carbon dioxide (CO_2) emissions in electricity production by 2030, and a 40% reduction by 2050. It envisions achieving these targets by, among other actions, phasing out ageing infrastructure, particularly in the power sector, increasing the use of renewables and alternatives to coal and oil, and promoting energy efficiency. In 2020, the government adopted an Action Plan for implementing the Green Economy Concept.

In 2014, the government approved the Concept for the Development of the Fuel and Energy Complex until 2030, and in June 2020 introduced an amended version of this document. The update provides an overview of the various energy subsectors, including the main issues and broad outlines regarding the government's plans to address them.

The collection, validation and dissemination of official statistics are the responsibility of the Bureau of National Statistics (BNS). Since 2015, the BNS increasingly has produced data following relevant international methodologies and standards. The Master Plan for Development of the National Statistical System of the Republic of Kazakhstan for 2017-2025 defines priorities for energy statistics.

The first household energy consumption survey was conducted in 2018, and the next one is planned for 2023. Such surveys are essential for obtaining disaggregated information that helps support the development of energy efficiency indicators to track the impacts of energy policies.

Kazakhstan has made ambitious commitments to reduce greenhouse gas (GHG) emissions and increase the share of renewables in electricity production. However, the country's current dependence on large reserves of inexpensive coal makes achieving these objectives a challenge.

Apart from renewables, prices for energy in Kazakhstan generally are not directly subsidised, but kept low through regulatory and administrative means. For example, tariffs for conventional power producers do not fully account for maintenance and replacement costs nor for environmental and climate externalities. As a result, renewable energy sources (RES) and other new generation capacity must compete with amortised coal plants that do not need to fully account for externalities.

Energy prices are a sensitive social concern in Kazakhstan. However, Kazakhstan may be able to learn from the experience of other countries that have successfully reduced or eliminated price distortions, for example by introducing increases over time and targeting end-user subsidies or welfare payments to the most vulnerable.

Oil and natural gas

Kazakhstan is the largest oil producer in Central Asia and a major gas producer. Most gas is associated with oil production, and around one-third is reinjected in order to boost liquids output. Production of both oil and gas is dominated by three international projects that began operations in the 1990s.

Kazakhstan has been successful in attracting the interest of major international investors in its oil and gas sector. However, a worldwide trend towards decarbonisation is making oil and gas companies more selective about developing new acreage. Given Kazakhstan's relatively high development costs for new upstream projects, coupled with long export routes, attracting investment is increasingly expected to depend on ensuring that fiscal and other policies are internationally competitive.

Around 80% of oil is exported. Almost all exports pass through Russia, mainly via the Caspian Pipeline Consortium (CPC) pipeline to the Black Sea port of Novorossiysk. A smaller pipeline to China is currently underused, while minor volumes are sent by tanker across the Caspian Sea to Azerbaijan, where they can enter the Baku-Tbilisi-Ceyhan

pipeline. Diversification of export routes is important for securing the flow of oil and gas to lucrative export markets, which provide important revenue for the Kazakh treasury.

Following a major refinery refurbishment programme, completed in 2018, Kazakhstan is essentially self-sufficient in oil products. However, very low domestic prices for oil products relative to those of its neighbours have led to unauthorised exports, in turn leading to periodic domestic shortages for some products.

Kazakhstan has been successful in rapidly expanding its domestic gas network. However, increasing gas supplies to meet domestic consumption and export goals appears to be a growing challenge. Producers generally have been reluctant to sell gas to the country's gas monopoly, QazaqGaz, because it is more economic for them to reinject the gas in order to boost oil production. QazaqGaz is limited in the price it can offer producers due to low retail prices set by the regulator. More attractive prices for gas would provide incentives for producers to sell more of it, as well as to explore for and develop new sources of supply for the government's ambitious plans to expand gas consumption.

Coal

Kazakhstan's coal reserves are among the largest in the world and relatively inexpensive to mine. Coal currently accounts for around 50% of Kazakhstan's energy supply, over 70% of its electricity generation and over 20% of final consumption. Kazakhstan has one of the highest rates of household coal use in the world.

Kazakh coal emits relatively large amounts of particulate matter and sulphur dioxide (SO_2) when combusted. As in many countries, more work is required to accurately quantify and control methane emissions from coal mines.

Many of Kazakhstan's coal-fired power plants are old, inefficient and highly polluting. The International Energy Agency (IEA) welcomes the government's plans under the new Environmental Code to promote investments in best available techniques (BAT) for the mitigation of certain non-CO_2 pollutants.

Electricity

The government aims to significantly reduce the share of generation from coal in order to help meet its environmental and climate goals. However, the country's abundance of inexpensive coal makes this a challenge.

Gas-fired power accounted for about 20% of generation in 2020, though most of this was in the oil- and gas-producing western power zone, which is isolated from the rest of the country. Most of the electricity generated from renewable sources in 2020 came from large hydropower plants (HPPs), much of whose capacity is tightly regulated by agricultural irrigation schedules. Wind and solar represented only around 1% of generation each in 2020.

Kazakhstan lacks flexible generating capacity and in practice relies significantly on parallel operation with the Russian power system to cover imbalances and maintain frequency stability. The shortage of flexible capacity is likely to become an increasing challenge as more intermittent renewables are added to the system.

As in other energy subsectors, the authorities are concerned about keeping end-user tariffs low for social welfare reasons. Although the country has introduced a number of market mechanisms over the years, these appear to have had limited impact, particularly for stimulating investment.

Kazakhstan ranks first in the world in uranium mining and is involved in other stages of the nuclear fuel cycle. The government has been publicly discussing the idea of building a commercial nuclear plant.

Renewable energy

The potential of Kazakhstan's RES is substantial, though the share of RES in total energy supply is currently low, varying between 1% and 2%. Kazakhstan is to be congratulated for meeting its target for producing 3% of power from RES by 2020. The country aims to generate 15% of its electricity from RES by 2030, not including large hydropower.

Currently over 130 RES facilities supply power to the grid with a total installed capacity of more than 2 gigawatts (GW), a 20-fold increase since 2011. Most RES is solar and wind, in addition to some 1.6 GW of large hydropower generating capacity.

Kazakhstan employed feed-in tariffs (FiTs) for several years, but began using auctions to determine tariffs for RES projects from 2018. Between that time and 2021, Kazakhstan organised auctions for over 1 700 megawatts (MW) of RES capacity, resulting in 75 projects. Auction-based power purchase agreements (PPAs) allow a project to sell all of its power to the designated centralised buyer of RES and benefit from prioritised dispatching.

Integrating Kazakhstan's growing RES capacity is increasingly becoming a challenge. Kazakhstan's power system has a large amount of coal-fired baseload capacity, but very little of the flexible capacity that can be quickly powered up or down to complement the intermittent nature of RES.

In December 2021, Kazakhstan began using auctions similar to those for RES to attract investment in new flexible generating capacity, such as large gas-fired and hydropower projects. The IEA welcomes this initiative, which the government should consider further expanding.

There is currently no incentive for RES projects in Kazakhstan to include storage, since auction rules do not require it and the resulting PPAs absolve developers of any financial responsibility for balancing. Unfortunately, including storage would add significant costs to RES projects, in turn requiring tariffs that may be substantially higher than those currently in use.

If tariffs fully took into account long-run upgrade and replacement costs and environmental and climate externalities of conventional power producers, RES probably would be in a substantially better position to compete in the power market, including for the development of flexibility in the form of energy storage.

Energy efficiency

Kazakhstan has experienced significant GDP growth without a concurrent increase in energy intensity. However, its economy remains highly energy-intensive, with a strong reliance on fossil fuels across most sectors. Both residential and transport sector consumption have increased considerably in absolute terms since 2010.

Policies to increase energy efficiency are present across all sectors, and energy efficiency has been identified as a priority by the government. However, efforts to achieve progress are complicated by low energy tariffs, lack of secondary legislation and implementing measures, and the absence of a central co-ordinating body for energy efficiency across governmental departments.

Very low energy tariffs that do not fully cover costs create barriers to investment and effective policy design and implementation across many sectors. As a result, end consumers are not aware of the full cost of energy and have few incentives to reduce their consumption through the purchase of more energy-efficient equipment.

In the buildings sector, existing measures do not equate to a comprehensive set of codes covering new construction and major retrofits, while energy passports are not being effectively enforced by local authorities. In rural areas reliance on coal creates climate and health concerns, and in urban settings outdated district heating systems and lack of metering reduce efficiency.

The potential to increase the efficiency of appliances and energy-using equipment remains largely untapped, though efforts are under way with support from international partners to improve existing frameworks for minimum energy performance standards (MEPS).

In transport, vehicle fuel economy standards and import bans on older vehicles are not effectively enforced, and robust testing regimes are lacking. In the industry sector, existing energy performance and energy audit requirements are also poorly enforced, resulting in energy efficiency potentials in industry remaining largely untapped.

Energy, environment and climate change

Kazakhstan joined the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and ratified the Kyoto Protocol in 2009. In 2016, it ratified the Paris Agreement and pledged to reduce its GHG emissions to 15% below 1990 levels by 2030 (including land use, land-use change and forestry [LULUCF]) as an unconditional target, and by 25% conditional to receiving additional international assistance. Kazakhstan's 2021 Environmental Code requires state bodies to take actions aimed at ensuring the fulfilment of these targets.

The CO_2 intensity of Kazakhstan's GDP is nearly 70% higher than the world average, reflecting the structure of its economy, which includes energy-intensive heavy industries and a reliance on coal in electricity generation. According to Kazakhstan's latest national inventory report to the UNFCCC, energy-related emissions in 2020 accounted for around 80% of its total GHG emissions, excluding effects from land use. In 2020, fuel combustion was the largest source (90%) of emissions from Kazakhstan's energy sector, while fugitive emissions accounted for the remaining 10%.

President Kassym-Jomart Tokayev's pledge in 2021 to achieve carbon net neutrality by 2060 gave a significant boost to the development of climate policies. The draft Strategy to Achieve Carbon Neutrality by 2060 is currently undergoing a revision and discussion process. A revised Nationally Determined Contribution (NDC) and implementation roadmap for it have also recently been developed, though not yet approved.

Kazakhstan has made considerable progress in improving its Environmental Code, which entered in force in July 2021 and includes policies to promote BAT. It also envisages policies for climate change mitigation and adaptation and establishes a "carbon budget", which is to be co-ordinated with the country's international commitments.

Kazakhstan is the first country in the Former Soviet Union (FSU) to introduce an emissions trading scheme (ETS). Despite several amendments and fine-tuning, however, the number of transactions has been extremely low. Important reasons for this include the large number of free quotas and relatively high benchmarking coefficients, particularly for coal-fired power plants. Non-ETS sectors, including transport, the residential sector and services, are increasing their energy consumption and GHG emissions, while policies and measures to reduce emissions from these sectors have yet to be developed.

Key recommendations

The government of Kazakhstan should:

- To the extent possible, ensure that all energy prices take into account long-run marginal costs and environmental externalities, in order to provide sufficient incentives to pursue energy efficiency, and to level the playing field for and stimulate the development of new sources of supply. Any price rises should be accompanied by policies to mitigate their impact on the most vulnerable segments of the population.
- Maintain close co-operation with the BNS and continue using official energy statistics as the foundation for analysis in strategic documents and when drafting new legislation.
- Prioritise the diversification of oil export routes.
- Continue and expand auctions to build RES and flexible capacity.
- Prioritise the development of an efficient balancing market in order to stimulate the efficient development and use of balancing capacity, which will be increasingly needed for the integration of RES.
- Adopt the NDC implementation roadmap.
- Adopt policy measures to reduce emissions from sectors not covered by ETS, including transport, the residential sector and services.
- Intensify efforts to reduce emissions from coal-fired power plants by adopting more stringent air pollution standards for such plants, including through BAT, and ensuring enforcement. Ensure that Kazakhstan's BAT and technical emissions standards are in line with international best practice.

2. General energy policy

Key data

(2020)

TES: 65.7 Mtoe (coal 49.7%, natural gas 30.7%, oil 18.0%, hydro 1.3%, solar 0.2%, wind 0.1%, bioenergy 0.1%), -5.0% since 2010

TES per capita: 3.5 toe/cap (world average 2019: 1.9 toe/cap)

TES per unit of GDP: 145 toe/USD million PPP (world average 2019: 114 toe/USD million PPP)

Energy production: 159.0 Mtoe (oil 54.9%, coal 27.9%, natural gas 16.6%, hydro 0.5%, solar 0.1%, wind 0.1%, bioenergy <0.1%), +1.4% since 2010

TFC: 40.3 Mtoe (oil 30.9%, coal 21.6%, district heat 16.3%, natural gas 16.1%, electricity 14.9%, bioenergy 0.1%), +4.0% since 2010

Overview

The Republic of Kazakhstan is the largest of the former Soviet Republics in Central Asia, as well as the region's largest energy producer. It is bordered in the north by Russia, in the east by China, in the south by Kyrgyzstan and Uzbekistan, and in the west by Turkmenistan and the Caspian Sea. The country has a land area of 2 717 300 km^2, a coastline of 1 894 km on the Caspian Sea, and a population of 18.7 million.

Until 2015, Kazakhstan was one the world's fastest-growing economies. Although real GDP growth was 4.5% in 2019, its economy contracted by an estimated 3% in 2020, largely due to the global pandemic, which, among other impacts, lowered world demand for oil, Kazakhstan's largest export commodity. The economy began to rebound in 2021, but in 2022 has been impacted by the conflict in Ukraine. Most of Kazakhstan's energy exports pass through Russia.

The oil and gas industries and related sectors accounted for 17% of GDP in 2020. Oil accounts for most of the country's export earnings and serves as the main source of government revenue.

Figure 2.1 Map of Kazakhstan

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

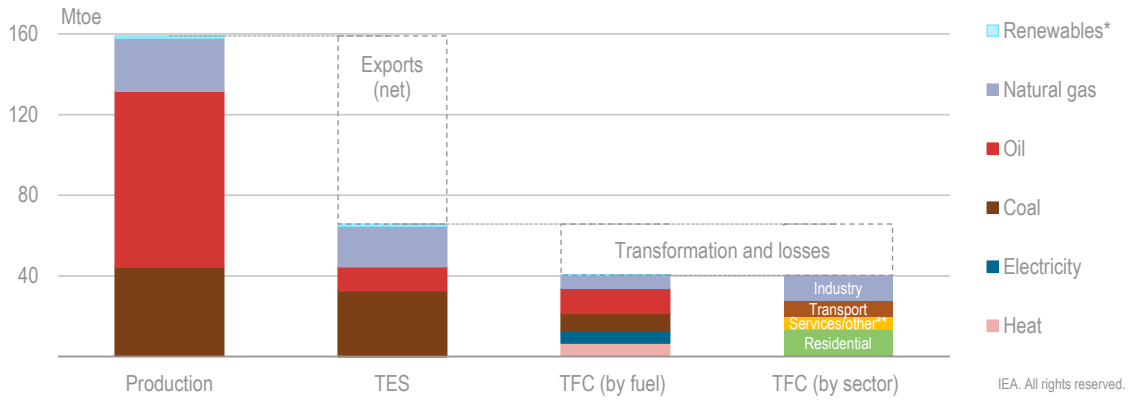
Energy supply and demand

Thanks to its natural resource reserves and production capacity of coal, oil and natural gas, Kazakhstan produces more energy than it requires to meet its own needs. In 2020 Kazakhstan exported almost 60% of domestic energy production.

Fossil fuels historically account for virtually all of total energy supply (TES). Coal was the largest energy source in 2020 (50% of TES), followed by natural gas (31%) and oil (18%). The contribution of renewables is currently modest at less than 2%.

Almost one-third of TFC in 2020 was covered by oil (31%), followed by coal (22%), while heat, natural gas and electricity each accounted for around 15%. Consumption by the residential sector has grown quickly, accounting for 33% of TFC in 2020. It surpassed industry (32%) as the largest consuming sector in 2020. Transport accounted for 18% of TFC, while the remainder (16%) was consumed by services and other sectors.

Figure 2.2 Overview of Kazakhstan's energy system by fuel and sector, 2020



Kazakhstan exports around 60% of its energy production.

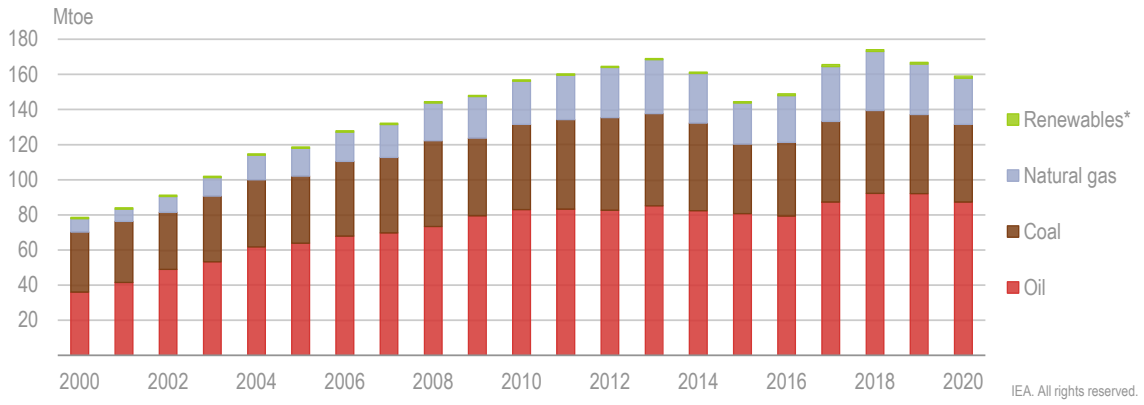
* Includes hydro, wind, solar photovoltaic (PV) and solid biofuels.
** Includes commercial and public services, agriculture and forestry.
Notes: Mtoe = million tonnes of oil equivalent. Bunker fuels of around 0.3 Mtoe are not included in TES. Electricity exports accounting for 0.1% of TES (negative) are not shown in the chart.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Energy production and self-sufficiency

Oil accounted for over 50% of Kazakhstan's domestic energy production of 159 Mtoe in 2020. While oil production in 2020 was somewhat less than it was two years earlier, it was still more than double the level of the early 2000s.

Kazakhstan's second main source of energy production is coal, which accounted for 28% of total production in 2020, followed by natural gas (17%).

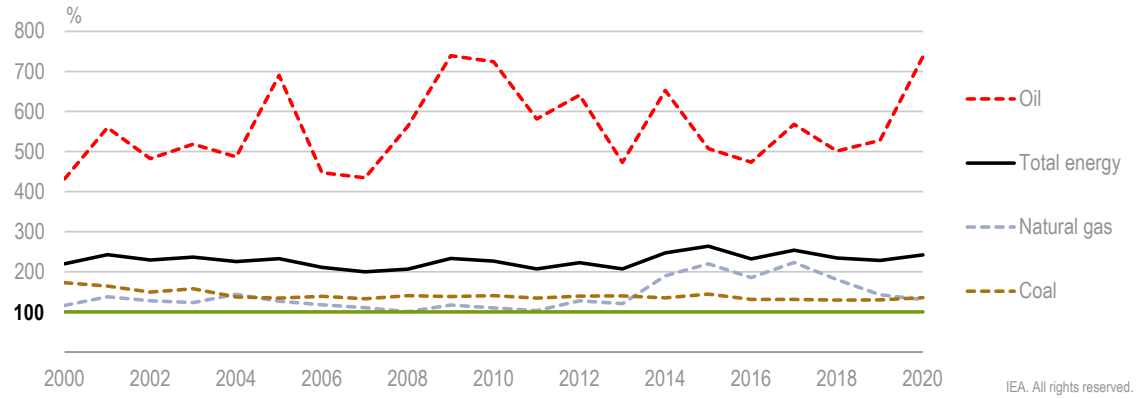
Figure 2.3 Primary energy production by source, 2000-2020



Kazakhstan is a major producer of all fossil fuels.

* Includes hydro, solar PV, wind and bioenergy; not visible at this scale.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 2.4 Self-sufficiency by energy source, 2000-2020



Kazakhstan is a major exporter of crude oil.

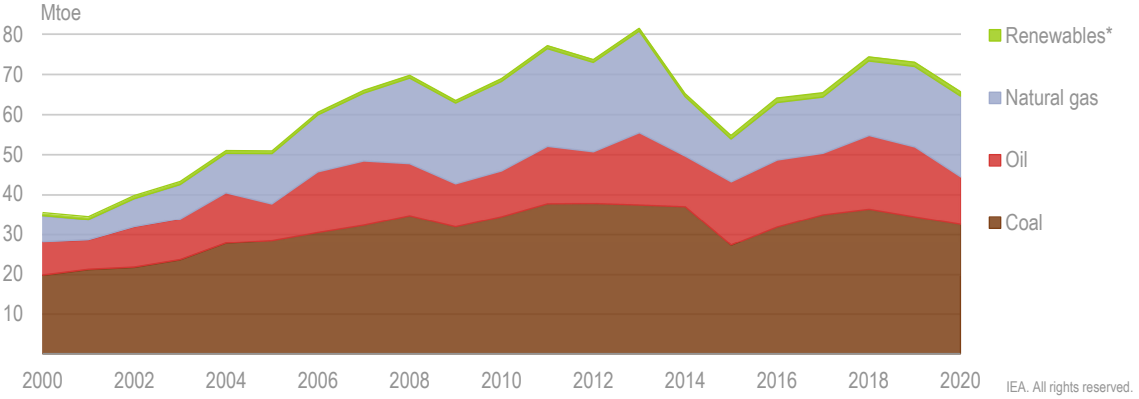
Note: Self-sufficiency is calculated by domestic production over TES. Value above 100% indicates the country produces more than it consumes, making it a net exporter of energy.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Kazakhstan's significant overall energy surplus (self-sufficiency) has remained stable over the last two decades, averaging 230% of the energy supply needed to cover domestic demand. In 2020, domestic production of oil accounted for 737% of Kazakhstan's domestic energy needs, coal accounted for 136% and natural gas accounted for 131%. This has allowed Kazakhstan to be a large net exporter of fossil fuels.

Kazakhstan's TES stood at 65.7 Mtoe in 2020 (-5% since 2010). Coal accounted for 50% of TES, gas for 31% and oil for 18%. Renewables (mainly hydro) covered less than 2% of TES. The share of fossil fuels is thus around 98% of TES, high compared with the world average, which in 2019 was 81%.

Coal forms the backbone of Kazakhstan's energy system. Its share in TES remained above 50% of total energy demand between 2000 and 2020, a period when coal consumption grew by 65%. However, natural gas demand saw the relatively strongest growth over that period: Following an expansion of the gas network, natural gas consumption more than tripled, while domestic oil demand grew by 42%.

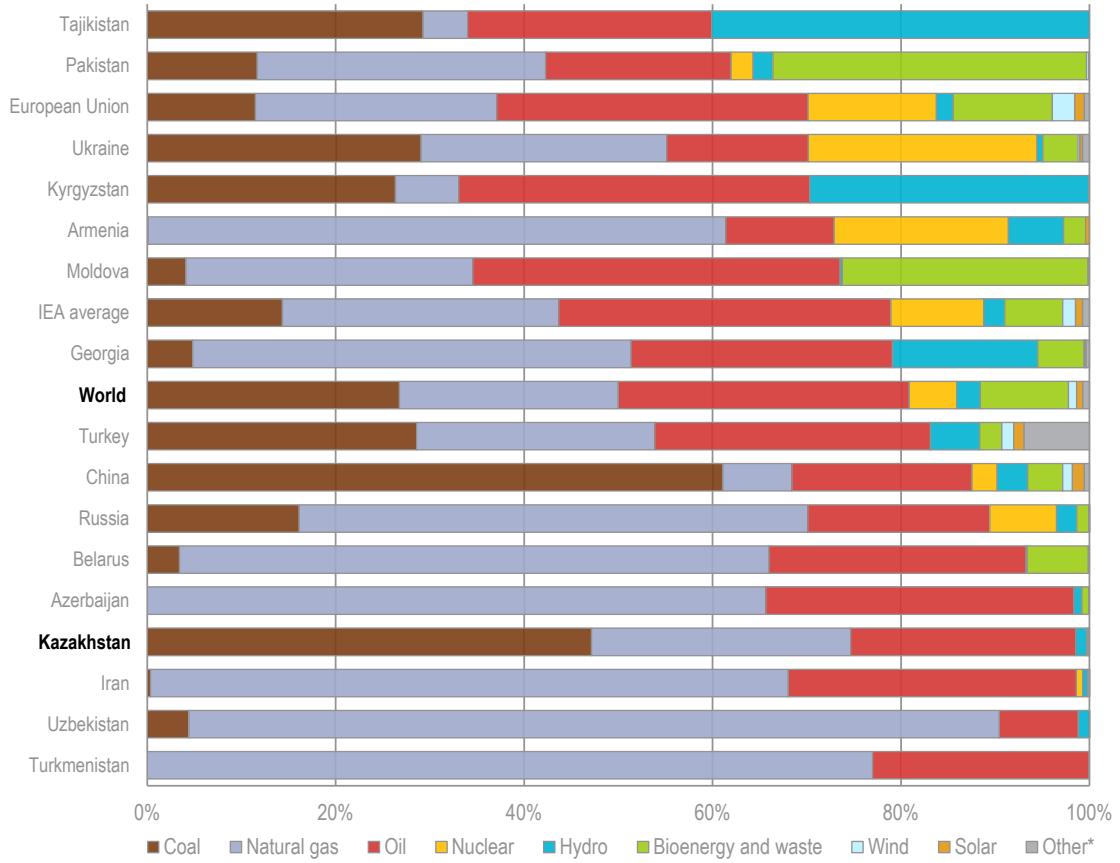
Figure 2.5 Total energy supply by source, 2000-2020



Kazakhstan's TES is dominated by coal.

* Includes hydro, solar PV, wind and bioenergy
Note: Electricity trade is not included in the graph.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 2.6 Breakdown of TES in selected countries, 2019



The share of coal in Kazakhstan's energy supply is nearly double the world average.

* Includes geothermal, primary heat, wave and ocean energy.
Note: Electricity trade not included.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

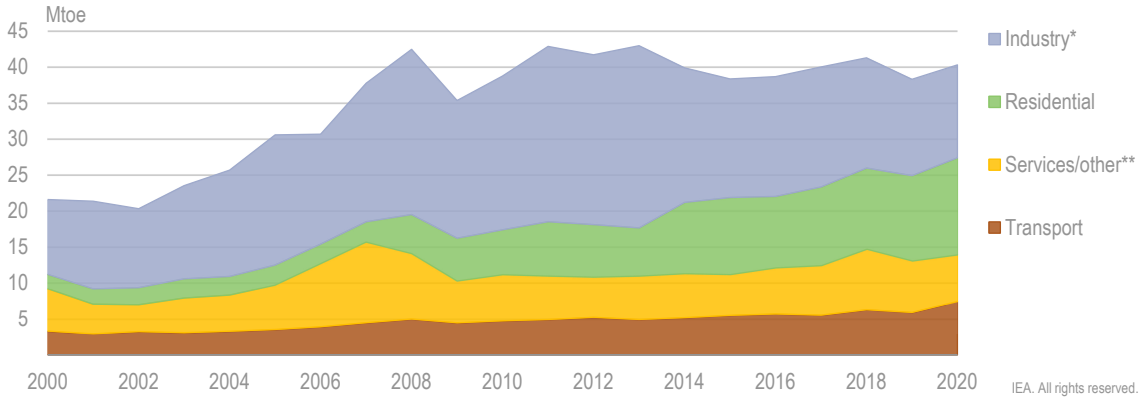
Energy consumption

Kazakhstan's TFC amounted to 40.3 Mtoe in 2020 (+4% since 2010). The residential sector is the largest consumer with a share of 33%; it also showed the fastest growth over the last decade (+116% since 2010). Industry consumed 32% of TFC in 2020. According to the available data, industry's consumption fell almost 40% between 2010 and 2020. However, some of the apparent decrease may be due to improved statistical reporting regarding industrial consumption in recent years and therefore should be treated with caution.

While the share of transport in TFC was relatively low at 18% in 2020, it had grown almost 60% since 2010. The remaining 16% of TFC was mainly consumed in services and agriculture.

Most coal is used for electricity and heat generation, while most oil is used by final consumers, particularly in road transport. The share of oil in final consumption was 31% in 2020, followed by coal (22%). Heat (mainly district heat), natural gas and electricity held similar shares (15-16%) of the total. Altogether, fossil fuels accounted for 69% of TFC in 2020.

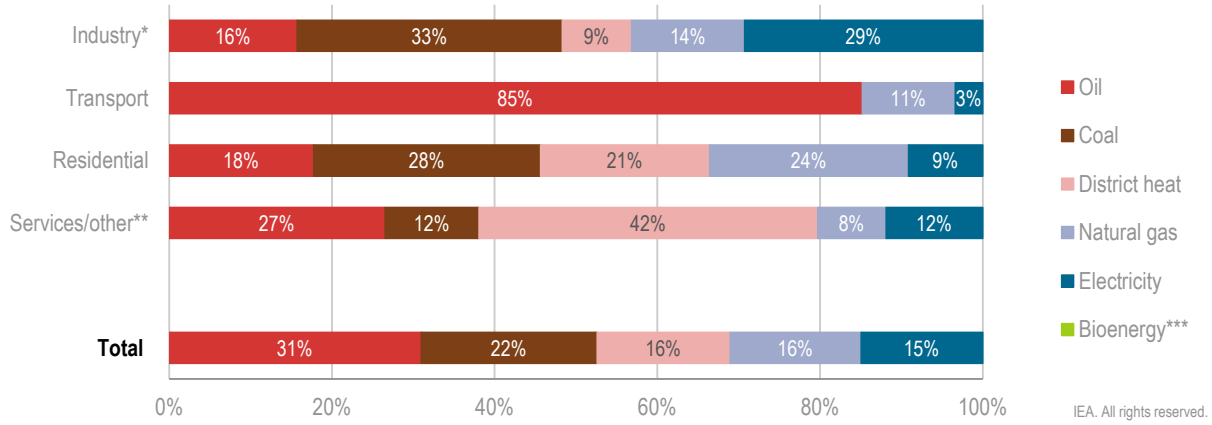
Figure 2.7 Total final consumption by sector, 2000-2020



Final consumption of energy has almost doubled since 2000.

* Includes non-energy consumption.
** Includes commercial and public services, agriculture and forestry as well as unspecified energy consumption (4% of TFC in 2020).
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 2.8 Total final consumption by source and sector, 2020



Energy sources in final consumption are diverse.

* Includes non-energy consumption.
** Includes commercial and public services, agriculture and forestry.
*** Includes consumption of solid biofuels in the residential sector; not visible at this scale.
Note: For ease of readability, shares of less than 1% are not shown. Therefore, numbers may not add up to 100%.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Energy sector governance

The main institutions in Kazakhstan's energy sector are the following:

The **Ministry of Energy** is the main policy-making body, with regulatory authority over oil and gas exploration and production, oil refining, gas processing, the coal sector, and nuclear energy.

The **Ministry of National Economy** is responsible for macroeconomic policy. It also oversees the country's long-term carbon-neutral development. Its **Committee for the**

Regulation of Natural Monopolies and Protection of Competition (KREM) regulates the electricity and gas networks, as well as retail prices for power and gas.

The **Ministry of Ecology, Geology and Natural Resources (MEGNR)** is responsible for environmental protection policy and the development of the "green economy". It regulates environmental impacts in the energy sector through its **Committee for Environmental Regulation and Control**. MEGNR's **Department of Climate Policy and Green Technologies** is responsible for climate policy and the implementation of UNFCCC-related commitments and other international agreements and protocols in the field of climate change and the ozone layer.

Joint-stock company (JSC) **Zhasyl Damu** is an organisation under MEGNR responsible for developing and maintaining Kazakhstan's GHG emissions inventory and managing the country's system for regulating and trading GHG quotas.

The **Ministry of Industry and Infrastructure Development** is responsible for industrial policy covering the country's most important energy-consuming industries, which include mining, metallurgy and chemicals. Its **Committee for Industrial Development** has primary responsibility for energy efficiency.

The **Bureau of National Statistics (BNS)** under the **Agency for Strategic Planning and Reforms of the Republic of Kazakhstan** is the main provider of energy statistics, as well as activity data required for the assessment of GHG emissions used in Kazakhstan's reporting under the UNFCCC.

Samruk-Kazyna JSC is the country's sovereign wealth fund that owns and manages the state's share in companies, including several in the energy sector, such as the state oil and gas firm, KazMunayGas (KMG); KMG's gas production and transport subsidiary, QazaqGaz (until recently KazTransGas); and the electricity transmission and system operator, Kazakhstan Electricity Grid Operating Company (KEGOC).

Key policy documents and legislation

In 2012, the government launched the Kazakhstan 2050 Strategy, which identified policies and reforms aimed at placing Kazakhstan among the top 30 economies in the world by 2050.[1] Among other things, the strategy aims for "alternative" and "green" energy technologies to account for half of all energy consumed in the country by 2050.

The 2013 Concept for the Transition to a Green Economy (Green Economy Concept) calls for the country to generate 50% of its electricity by 2050 from "alternative or renewable" sources, which might include gas and nuclear in addition to RES. It also calls for a 15% reduction in CO_2 emissions in electricity production by 2030, and a 40% reduction by 2050. It envisions achieving these targets by, among other actions, phasing out ageing infrastructure, particularly in the power sector, increasing the use of renewables and alternatives to coal and oil, and promoting energy efficiency. In 2020, the government adopted an Action Plan for implementing the Green Economy Concept.

Kazakhstan has created several laws and resolutions to support renewables. In 2009, Kazakhstan established the Financial Settlement Centre for Renewable Sources Support

[1] https://kazakhstan2050.com/.

LLP (FSC), which a later government decree empowered to serve as the centralised buyer and seller of RES. A 2014 government resolution provided for guaranteed FiTs payable by FSC to RES developers, while amendments in 2017 to the Law on the Support of the Use of RES required tariffs for RES developed from 2018 to be determined by auctions, and amendments in 2020 extended the duration of auction-determined tariffs from 15 years to 20.

Kazakhstan ratified the Paris Agreement in 2016. As part of its NDC under the UNFCCC, it pledged to reduce its GHG emissions to 15% below 1990 levels by 2030 (including LULUCF) as an unconditional target, and by 25% conditional to receiving additional international assistance. Kazakhstan's 2021 Environmental Code requires state bodies to take actions aimed at ensuring the fulfilment of these targets. Kazakhstan's 2015 NDC states that its GHG emissions reductions will be achieved by the implementation of the Green Economy Concept, and adoption of related legislative acts intended to promote the modernisation of key infrastructure and the production base, based on energy-efficient technologies. The NDC outlines key laws, such as On Energy Saving and Energy Efficiency and On Supporting the Use of Renewable Energy Sources, which aim to create favourable conditions for the adoption of RES and energy-efficient technologies. An NDC implementation roadmap has been developed but not yet approved.

In 2020, President Tokayev announced that Kazakhstan would achieve carbon neutrality by 2060. In this context, MEGNR has been working on a Draft Strategy for Achieving Carbon Neutrality.

In January 2021, Kazakhstan adopted a New Environmental Code which, among other things, introduces a carbon budget and policies to support the introduction of BAT for Kazakhstan's most polluting enterprises, including power plants.

In 2014, the government approved the Concept for the Development of the Fuel and Energy Complex until 2030, and in June 2020 introduced an amended version of this document. The updated document provides an overview of the various energy subsectors, including the main issues and broad outlines regarding the government's plans to address them. However, it is unclear to what extent it is being used to guide energy policy in practice.

In 2022, the Ministry of Energy approved the Energy Balance until 2035, which forecasts supply and demand and is expected to guide government policies and plans, particularly in the power sector.

Energy statistics

The collection, validation and dissemination of official statistics are the responsibility of the BNS, which is under the Agency for Strategic Planning and Reforms.[2] Formerly called the Committee on Statistics under the Ministry of Economy, the BNS was re-established in its current form at the beginning of 2021 as part of wider government reforms. The BNS's new position within the government structure is expected to result in a higher profile and lead to better resourcing for energy statistics.

[2] Law No. 257-IV ZRK of the Republic of Kazakhstan on State Statistics, adopted on 19 March, amended on 31 December 2021.

The BNS produces annual and monthly energy statistics regarding the production and consumption of energy commodities and makes much of this data publicly available.[3] However, no public information or statistics are available on oil stocks or related reporting mechanisms. Energy statistics are currently overseen by the BNS's Department of Services and Energy Statistics.

Since 2015, BNS increasingly has produced data following relevant international methodologies and standards (UNSD, 2022) The Master Plan for Development of the National Statistical System of the Republic of Kazakhstan for 2017-2025 defines priorities for energy statistics. In 2021, the main energy data collection forms were revised to more accurately obtain information from Kazakhstan's energy sector.

The first household energy consumption survey was conducted in 2018, and the next is planned for 2023. Such surveys are essential for obtaining disaggregated information on types of energy and technologies used in the residential sector. This in turn helps support the development of energy efficiency indicators to track the impacts of sectoral energy policies.

The BNS has regular collaboration with the main government data users, building trust in and knowledge of the available data. The main national users of energy data include the Ministry of Energy and Zhasyl Damu, which is responsible for climate-related reporting under the UNFCCC. The BNS also co-operates and regularly shares energy data with international organisations, including the IEA, the United Nations Statistics Division (UNSD), and the Joint Organisations Data Initiative (JODI).

2015 review

The 2015 IEA publication *Eastern Europe, Caucasus and Central Asia* included the following main policy recommendations for Kazakhstan (IEA, 2015). Each recommendation from that review is followed by a brief update on how Kazakhstan has addressed it so far.

- Continue to develop the national fuel and energy strategy to 2030 with an outlook to 2050. Consider extending policy scenarios based on fuel switching with various price alternatives by developing additional scenarios analysing a range of fuel mixes and demand-side options.

The Concept for the Development of the Fuel and Energy Complex to 2030 was approved in 2014. Since then, there have been a number of amendments, most recently in June 2020. However, it is unclear to what extent it is actually guiding policy.

- Maximise the use of existing energy data, identify additional data requirement, take steps to acquire and keep up-to-date the data necessary to develop tools for strategic planning and monitoring the supply, demand and consumption of energy throughout the economy.

There have been a number of improvements in the area of energy data since 2015. In 2022, a separate energy statistics unit was created within the BNS providing the BNS with more authority to collect data.

[3] https://stat.gov.kz/.

In 2021, the country's annual data collection forms were aligned with international standards to allow for the development of the national energy balance in the internationally comparable (IEA) format. This should allow further monitoring and analysis of energy developments.

In 2018, Kazakhstan conducted its first household energy consumption survey, and a new and improved household survey is planned for 2023.

- Consider establishing an analytical centre to interpret statistics and provide modelling to inform policy making.

No such analytical centre has been established.

- Continue the development of the new electricity generation capacity market model for 2016 by managing the proposals, selection and implementation of the most suitable model in a timely and efficient manner. The system to be implemented needs to provide incentives and security for investment, and facilitate the sustainable development of energy infrastructure while maintaining reasonable cost to consumers.

A capacity market was launched in 2019. However, as noted by Kazenergy (2021), it has a number of deficiencies, including lack of sufficient market mechanisms for selecting and pricing the capacity of retrofitted plants.

- Maximise energy efficiency gains by co-ordinating effective implementation of demand-side policies, especially in the energy efficiency and district heating segments. Scale up the efforts to raise public awareness of available mechanisms and incentives for energy savings, with particular emphasis on the buildings, residential and transport sectors.

Demand-side policies are mainly aimed at energy efficiency in industry. There are still few policies covering efficiency in district heating systems, transport, buildings and the residential sector. A draft law on heat energy has been developed but has not yet been adopted. However, the main barrier to effective policies to improve energy efficiency is low energy prices.

- Ensure stable, predictable, fair and transparent investment procedures, with clear steps for energy sector investment developments to encourage the public and private investments required for effective energy markets.

This recommendation remains relevant. The Kazakh authorities appear to recognise the need to increase investment attractiveness.

Assessment

The revenue from the flow of oil and gas to lucrative export markets continues to be important for the Kazakh treasury. Most of Kazakhstan's oil and gas exports currently go via Russia. The invasion of Ukraine in 2022 highlights the importance of multiple routes as a component of energy security. Given Kazakhstan's geographic location and the fact that new pipeline routes can take years to develop, especially if they must cross through multiple countries, Kazakhstan's options for diversifying export routes are limited. Oil exports by tanker across the Caspian Sea to meet the Baku-Tbilisi-Ceyhan pipeline to Turkey's Mediterranean coast may be one of the quickest, most flexible ways to increase alternative oil export capacity.

Kazakhstan has made ambitious commitments to reduce GHG emissions and increase the share of renewables in electricity production. However, the country's current

dependence on large reserves of inexpensive coal makes such commitments a challenge. Reducing the amount of free credits within Kazakhstan's ETS, raising benchmarks within the programme to introduce BAT, and introducing more stringent criteria for participation in the electricity capacity market are examples of existing opportunities that could be used to further encourage more efficient use of coal and the replacement of coal by less-polluting energy sources.

Kazakhstan is to be congratulated for meeting its 2020 goal to have renewables account for 3% of electricity production, and for the auctions that have helped bring down tariffs for RES. Without the current rules that provide priority dispatching and guaranteed offtake of all RES electricity production at guaranteed prices, however, it would be nearly impossible for renewables to compete with conventional power producers, because tariffs for the latter do not appear to fully account for maintenance and replacement costs, let alone environmental and climate externalities. As a result, RES and all other new generation capacity must compete with fully amortised coal plants that do not need to fully account for externalities – but which also are not left with enough capital to increase efficiency and lower their environmental impacts.

Further increasing the role of intermittent renewables, such as solar and wind power, also depends on increasing flexibility in the power system, since the coal-fired plants that dominate Kazakhstan's power system are baseload and unable to quickly ramp up or down to cover periods when the sun does not shine or the wind does not blow. To provide more flexibility, Kazakhstan will need to add more gas-fired and/or hydroelectric plants and/or add electricity storage capacity. Tariffs that more fully take into account the full costs of coal-fired power would help level the playing field not only for RES but for developers of flexible capacity.

Apart from RES, prices for energy in Kazakhstan generally are not directly subsidised, but kept low through regulation and administrative means. For example, end-user prices for gas are low in large part due to below-cost prices paid by the country's gas monopoly for the associated gas produced by the country's main international projects. However, these projects, whose main output is oil or natural gas liquids for the international market, have generally found it more profitable to reinject their associated gas in order to boost the output of liquids rather than supply gas to the domestic market. More attractive prices for gas would provide incentives for producers to sell more of it, as well as to explore for and develop new sources of supply for the government's ambitious plans to expand domestic gas consumption.

In the domestic oil products market, prices are kept low in part by limiting the ability of certain producers to export, so that crude prices paid by domestic refineries are far below international prices. Unfortunately, the resulting low prices for oil products have sometimes led to unauthorised exports to Kazakhstan's neighbours, in turn leading to periodic domestic shortages.

The IEA recognises that energy prices are a sensitive social concern in Kazakhstan. For example, it was apparently an increase in the price of liquefied natural gas (LNG) for private vehicles that initially sparked the unrest that gripped the country in January 2022. However, Kazakhstan may be able to learn from the experience of other countries that have successfully reduced or eliminated price distortions, for example by introducing increases over time and targeting end-user subsidies or welfare payments to the most vulnerable.

The BNS has made a strong effort to improve energy demand data collection with support from the EU4Energy programme. The revision of the main energy data collection in 2021 will allow closer alignment of Kazakhstan's national energy statistics (including the energy balance) with the international methodology. The BNS should also be commended for establishing a process for conducting household energy consumption surveys, the first of which took place in 2018. The next household energy consumption survey, planned for 2023, will result in disaggregated information on the types of energy and technologies used in the residential sector, including for the development of sectoral energy efficiency policies. It is essential to provide sufficient resources for conducting such surveys and to take into account the lessons learned from the first survey conducted in 2018.

The energy sector plays a major role in Kazakhstan's economy, and the sector is more complex in Kazakhstan than in many other countries. Moreover, improved data collection and the household survey will result in increased volumes of data to process. However, there is no dedicated energy statistics team and only three people in the BNS (as of mid-2022) working on energy data. This resource challenge was noted by the master plan for developing statistics, which recommends increasing the number of staff working on such statistics, and by the latest global assessment of the national statistical system, which suggests establishing a team specialising solely on energy statistics (UNECE, 2017). These recommendations are strongly seconded by the IEA review team. Additional resources would allow e.g. for full specialisation on the energy statistics within the team; expansion of energy data production, notably including energy efficiency indicators; implementation of improved quality control mechanisms unique to energy data; and stronger co-ordination of activities around energy data with key stakeholders, particularly Zhasyl Damu.

A wealth of energy information is already available online. However, finding the right information can be challenging. Furthermore, some data are released in a format that is difficult to use. As additional data will become available through improved data collection, it will be worthwhile to develop a dissemination strategy specifically for energy statistics, taking into account users' needs.

Given Kazakhstan's role as a large producer and net exporter of energy, the data on energy supply are scrutinised internationally. Existing data discrepancies among different government entities create confusion and undermine trust in the official statistics. It therefore may be highly beneficial to establish a permanent national working group around energy statistics to ensure data consistency. For added transparency, it may also be useful to publish joint datasets according to different national reporting conventions, particularly for natural gas.

Development of energy efficiency indicators is essential for planning and tracking the progress of energy efficiency policies, and the BNS is to be commended for proactively starting work on this. This demanding exercise should benefit from international best practice and be allocated sufficient staff resources with capacity-building opportunities. Most importantly, stakeholder co-operation (BNS, Ministry of Economy, and other government entities) is essential, given that energy efficiency cuts across all sectors of the economy.

Recommendations

The government of Kazakhstan should:

- To the extent possible, ensure that all energy prices take into account long-run marginal costs and environmental externalities, in order to provide sufficient incentives to pursue energy efficiency, and to level the playing field for and stimulate the development of new sources of supply. Any price rises should be accompanied by policies to mitigate their impact on the most vulnerable segments of the population.
- Maintain close co-operation with the BNS and continue using official energy statistics as the foundation for analysis in strategic documents and when drafting new legislation.
- Provide sufficient resources (human and financial) for the BNS to implement the recommendations for energy statistics from the Master Plan for the National Statistical System and the 2017 Global Statistical Assessment. Encourage the BNS to update the master plan for the development of statistics periodically to ensure continuous improvement of energy statistics.
- Assign the BNS (and provide corresponding funding) to develop energy efficiency indicators and analysis according to the international methodology, in order to track the impact of sectoral energy efficiency policies (industry, transport, residential, services).
- Continue conducting household energy consumption surveys at regular intervals (e.g. every five years) in order to monitor the results of energy efficiency policies in the residential sector.
- Engage with the BNS and other data providers and users (e.g. Zhasyl Damu) to ensure all necessary energy statistics are accurate, available and accessible to all stakeholders, particularly regarding natural gas statistics.

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3. Oil and natural gas

Key data

(2020)

Oil production: 87.2 Mt

Net oil exports: 70.6 Mt

Net oil product exports: 3.5 Mt

Share of oil: 54.9% of domestic energy production, 18.0% of TES, 0.1% of electricity generation, 30.9% of TFC

Oil consumption by sector: 14.0 Mt (transport 44.9%, residential 16.2%, industry 14.5%, services/other 12.1%, other energy 10.9%, electricity and heat generation 1.4%), +29.9% since 2010

Gas production*: 29.9 bcm (18.4 bcm associated gas, 11.4 bcm non-associated gas)

Net gas exports: 7.4 bcm

Share of natural gas: 16.6% of domestic energy production, 30.7% of TES, 21.7% of electricity generation, 16.1% of TFC

Gas consumption by sector: 17.3 bcm (electricity and heat generation 42.1%, residential 21.7%, other energy 15.3%, industry 11.8%, transport 5.6%, services/other 3.6%)

*Marketable quantity, i.e. excluding quantities reinjected, vented or flared

Overview

Kazakhstan is the largest oil producer in Central Asia and one of its major gas producers. Most gas is associated with oil production, and around one-third of produced gas is reinjected back into the well to boost liquids output. Production of both oil and gas is dominated by three international projects that began operations in the 1990s.

Around 80% of oil is exported. Almost all exports go through Russia, mainly via the CPC pipeline to the Black Sea port of Novorossiysk. There is a smaller pipeline to China, while minor volumes are sent by tanker across the Caspian Sea to Azerbaijan, where they can enter the Baku-Tbilisi-Ceyhan pipeline to Turkey's Mediterranean coast.

Following a major refinery refurbishment programme, completed in 2018, Kazakhstan is essentially self-sufficient in oil products. However, very low domestic prices for products reportedly have led to problems with smuggling to neighbouring countries, particularly diesel fuel. Prices for oil products are considered a sensitive social issue.

The government aims to substantially expand gas use in the country, in part to phase out coal. The domestic gasification programme has been financed largely by gas exports to Russia and China. However, as more gas is diverted to the domestic market, where prices are kept very low, it will be difficult to continue subsidising domestic gasification and consumption with export earnings.

Reserves

Most of Kazakhstan's oil and gas reserves lie in the Precaspian Basin in the western and northern parts of the country, including offshore in the Caspian Sea.

The 2021 BP *Statistical Review of World Energy* ranked Kazakhstan's oil reserves the 12th largest in the world, with over 30 billion barrels of proven reserves (3.9 billion tonnes [Bt]). As of the beginning of 2019, Kazakhstan's State Commission on Reserves reported that the country had 4.5 Bt of crude oil reserves and 420 million tonnes (Mt) of condensate reserves (Kazenergy, 2021).

Kazakhstan's gas resources are among the 20 largest in the world. According to the BP *Statistical Review*, the country's total proven gas reserves were 2.3 trillion cubic metres (tcm) in 2020, or about 1.2% of the world total. Most of this is associated gas (BP, 2021). According to the State Commission on Reserves, as of the beginning of 2020, the country's recoverable gas reserves were 3.8 tcm,[4] which included 2.2 tcm of associated gas and 1.6 tcm of non-associated gas (MoE, 2021a).

The "big three" fields of Tengiz, Karachaganak and Kashagan account for over half the country's oil and gas reserves. The onshore Tengiz and offshore Kashagan fields are being developed primarily for their oil but also contain significant amounts of associated gas, while the onshore Karachaganak field primarily contains gas condensate.

Additional important gas reserves are found in the Korolev oil deposit in the Atyrau region and at the Zhanazhol and Urikhtau gas condensate fields in the Western and Aktobe oblasts respectively (MoE, 2021a; KTG, 2021).

Major recent oil finds include the Klymene prospect, announced in 2020 by Tethys Petroleum in the North Ustyurt Basin, with an estimated 224 million barrels (mb) of proven and probable oil reserves (Kazenergy, 2021), and the Khalel Uzbekgaliyev oilfield announced in 2021 by Meridian Petroleum, also in the North Ustyurt Basin. The latter is thought by some to be among the largest oil discoveries in Kazakhstan, though further work will be needed to determine its size (Eurasianet, 2021).

The national geological exploration programme for 2021-2025 was due to be finalised at the end of 2021, and expected to have a budget of about USD 400 million (Kazenergy, 2021).

[4] Note that Kazakhstan generally uses the Russian standard cubic metre, which contains a gross calorific value of 8 850 kilocalories (kcal), while the standard cubic metre used by the IEA contains 9 500 kcal. To convert from the Russian standard to the international standard, multiply by 0.931.

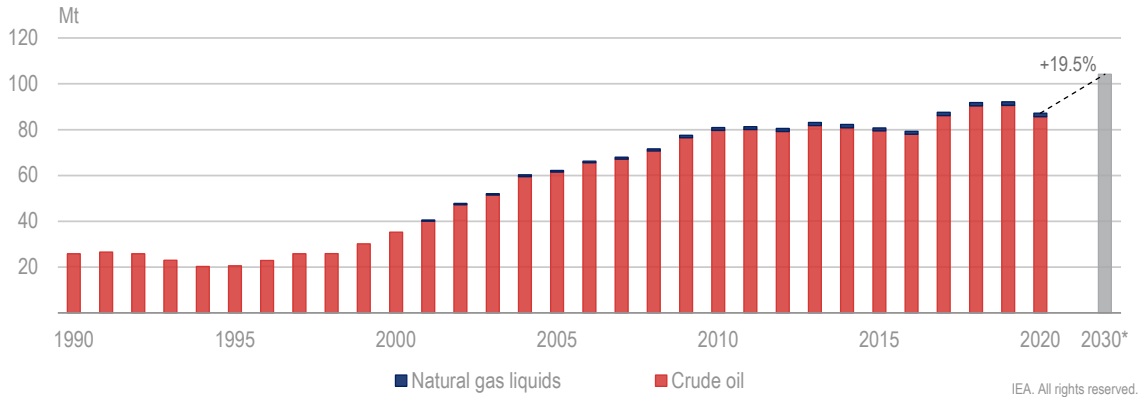
Production

Oil production

Kazakhstan produced 87.2 Mt of crude oil in 2020, an average of about 1.8 mb per day. This was down about 5% from the level in 2019 (MoE, 2021a). Oil production in 2021 was similarly expected to be around 86 Mt.

The government plans for oil production to reach 101 Mt by 2030. It expects the main growth factors to be implementation of the next phases of development for fields operated by the large international consortiums in the west of the country. IHS Markit predicts oil output will reach a maximum of 102 Mt sometime in the mid-2020s before gradually declining to around 73 Mt by 2050 (Kazenergy, 2021).

Figure 3.1 Oil production, 2000-2020



Oil production has nearly quadrupled since independence.

* 2030 production target included in the government plan.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Over 60% of current oil output, along with much of its gas output, is accounted for by the "big three" international mega-projects, Tengiz, Kashagan and Karachaganak.

Tengiz is an onshore oilfield developed by LLP Tengizchevroil (TCO), a joint venture (JV) among Chevron (50%), ExxonMobil (25%), KMG (20%), and LukArco (5%). TCO received a 40-year lease for Tengiz and the nearby Korolevskoye field in 1993. Tengiz is one of the deepest super-giants in the world and has estimated reserves of 25.5 billion b0 arrels of oil and 510 billion cubic metres (bcm) of gas (MoE, 2021a). Production during the first half of 2021 was around 600 000 barrels (bbl) per day. Much of the field's produced gas is reinjected to increase oil output (Chevron, 2021). A future increase in capacity of about 260 000 bbl per day is expected from two initiatives, the Wellhead Pressure Management Project, which is scheduled to start in 2023, and the Future Growth Project, which is expected to begin in 2024. The joint venture for this field expires in 2033, at which point the government has the option to take over operations (Kazenergy, 2021).

Kashagan is an offshore oilfield developed by the North Caspian Operating Company (NCOC), a JV among KazMunayGas, Eni, ExxonMobil, Royal Dutch Shell and Total (each with 16.81%), as well as China National Petroleum Corporation (CNPC) (8.4%), and Inpex (7.56%). Kashagan is the first Kazakh offshore field to be developed. The Kashagan contract was signed in 1997 and is set to run until 2041. The NCOC consortium is also

developing the nearby Kairan and Aktoy offshore fields (NCOC, 2021). Kashagan is located in shallow water (3-4 metres) with equipment erected on artificial islands. Recoverable oil is estimated at 9 billion bbl to 13 billion bbl, and gas reserves at 1 353 bcm (MoE, 2021a). The field began commercial production in 2016 and exports in 2017. Production capacity was about 370 thousand barrels per day in 2021, though actual output was around 200 kb/day, constrained by the OPEC+ agreement (see below). A planned de-bottlenecking programme is expected to increase production capacity by 80 kb/day (Kazenergy, 2021).

Karachaganak is an onshore gas condensate field developed by Karachaganak Petroleum Operating, a partnership between Royal Dutch Shell (29.25%) and Eni (29.25%), which are joint operators, along with Chevron (18%), Lukoil (13.5%), and KMG (10%). Karachaganak contains estimated gross reserves of over 2.4 billion bbl of condensate and 740 bcm of gas (MoE, 2021a). In 2020, hydrocarbon production was 143.9 mb of oil equivalent, including about 20 bcm of gas, around one-third of which was reinjected to maintain reservoir pressure (Karachaganak, 2021). Most of the remaining gas is sent to Russia's Orenburg facility for processing.

Other large projects with international investors include **AktobeMunayGas** and **PetroKazakhstan**, both of which are majority-owned by CNPC. Chinese-owned equity in Kazakh oil production in 2020 was about 16% of total production (Kazenergy, 2021).

Some 70-plus smaller companies together account for about 10-15% of Kazakhstan's oil output.

The state-owned integrated oil and gas company, **KMG**, has a stake in each of the major international projects. KMG also produces oil from its own fields, accounting for around 10% of Kazakh output in recent years in the fields where it is the operator. KMG was established in 2002 and represents the interests of the Kazakh state in the oil industry. It is 90.4% owned by Kazakhstan's sovereign wealth fund, Samruk-Kazyna. The government had originally scheduled an initial public offering for the company for the autumn of 2020, though this has been postponed (KMG, 2020).

The government views projects to expand production at Tengiz and Karachaganak as particularly important for increasing Kazakhstan's oil output over the next decade. Development of the Khazar and Kalamkas offshore fields in the Mangistau region are also seen as potentially significant, perhaps accounting for 4 Mt of new production per year from 2028 (Kazinform, 2021b).

OPEC+

Kazakhstan has been actively co-operating with OPEC+, which includes Russia and several other major non-OPEC producers in co-operation with the countries in the Organization of the Petroleum Exporting States.[5] The group reached a "mega-deal" in May 2020 to cut production in order to help stabilise crude oil prices in the face of falling demand during the Covid-19 pandemic. The deal was originally expected to last until April 2022 but was extended until December 2022.

[5] The 13 current members of OPEC are: Algeria, Angola, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Republic of the Congo, Saudi Arabia, the United Arab Emirates and Venezuela. The 10 additional countries that are members of OPEC+ are: Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, Russia, South Sudan and Sudan.

During 2021 and early 2022, the overall OPEC+ quota generally rose each month by 400 kb/day, with monthly increases for Kazakhstan of 16 kb/day. For example, in February 2022, Kazakhstan's quota rose from 1.572 mb/day to 1.589 mb/day, then to 1.605 mb/day the following month (Kazinform, 2022a). The quotas have constrained production at the Tengiz and Kashagan projects, though have had little impact on Karachaganak, since the OPEC+ agreement does not cover gas condensate. Crude production by state-owned KMG also has been relatively less affected, since KMG exports a smaller share of its output (Kazenergy, 2021).

In practice, the cuts undertaken by Kazakhstan so far under the OPEC+ agreement may not have been significantly greater than reductions already planned as part of works related to future expansion projects. It thus remains to be seen whether Kazakhstan will have an interest in continued co-operation with the cartel if such co-operation implies major reductions in the mid-2020s when Kazakh oil output is expected to significantly increase.

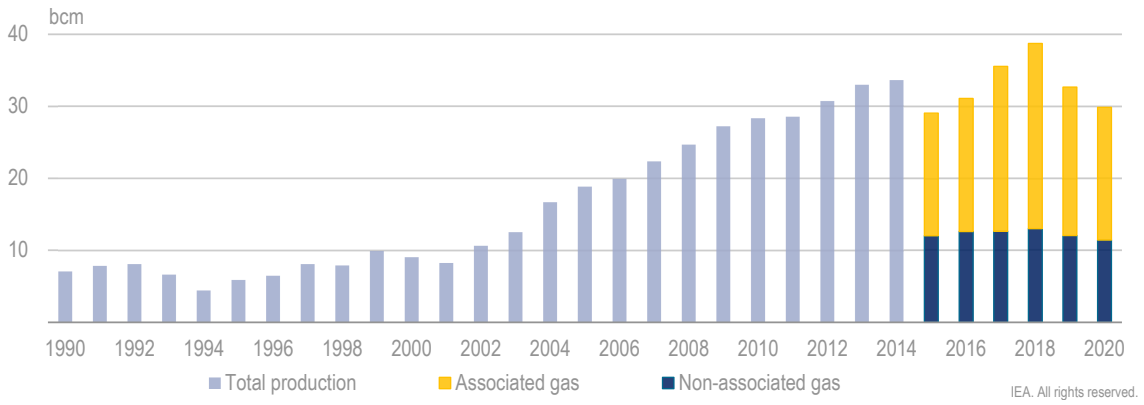
Gas production

More than half of gross gas production in Kazakhstan is associated with oil output, while much of the non-associated gas is from Karachaganak, a project focused on natural gas liquids. Since most large projects are primarily aimed at liquid hydrocarbon production, much of their gross gas output is reinjected in order to boost liquids output.

Gross gas production (i.e. including gas that is later reinjected) has grown about 4% annually since 2010 (Kazenergy, 2021), and reached 55.1 bcm in 2020 (MoE, 2021a). Much of the growth has been due to increases at the offshore Kashagan field (Kazenergy, 2019).

Of the 55.1 bcm produced in Kazakhstan in 2020, 31% (17.3 bcm) was reinjected, and 14% (7.3 bcm) was used by companies at the production site, e.g. for electricity generation. The remaining 55% of gross gas production was sent for processing (MoE, 2021a).

Figure 3.2 Natural gas production, 1990-2020



Most gas is associated and gas output has increased with oil production.

Notes: Represents marketable quantities, i.e. excluding quantities reinjected, vented or flared. 2020 data are preliminary. Split between associated and non-associated gas production available since 2015.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

The “big three” projects were responsible for about 80% of gross gas production and 70% of commercial gas supply in 2020 (Kazenergy, 2021). Tengiz accounted for 14.7 bcm (26.7%) of the country’s gross production, Karachaganak 20.2 bcm (36.7%), Kashagan 9.2 bcm (16.7%), and Zhanazhol 4.8 bcm (8.7%) (MoE, 2021a).

State-owned **QazaqGaz** (known until 2022 as KazTransGas) produced about 0.3 bcm of gas at its own fields, accounting for less than 1% of gross production (KTG, 2021). QazaqGaz’s main activity currently is the operation of Kazakhstan’s gas pipelines, though it has been expanding its activities throughout the gas value chain. While it does not currently produce large amounts of gas, it hopes to increase production at a number of deposits recently transferred to it by its parent company KMG and the National Welfare Fund – Samruk-Kazyna. In 2021 QazaqGaz obtained the status of national operator with guaranteed shares in new development projects with high gas production potential. QazaqGaz is already a partner in several joint ventures, including a 50% stake in Otan Gas LLP, which is co-owned by PetroChina Investment Holding BV (KTG, 2021).

The government expects gross annual gas production to increase to 87.1 bcm by 2030, based on increases at Karachaganak, Kashagan and Tengiz, as well as the development of several promising new fields, including Urikhtau, Tsentralnyi, Prorva Zapadnaya, Priodorozhnoye, Anabai, Rozhkovskoye, Ansaga, and Tokorevskaya. Over the same period, it expects annual commercial gas output to increase to 42.2 bcm, aided by the construction of new gas processing plants at Kashagan and Zhanaozen (Kazinform, 2021).

Licensing and investment conditions

Upstream oil and gas is the leading economic sector in the country, attracting over USD 70 billion in foreign direct investment over the past decade (KMG, 2020).

According to IHS Markit, Kazakhstan ranks 63rd out of 117 countries in investment attractiveness for exploration and production activities, slightly below Russia (Kazenergy, 2021). This is because Kazakhstan’s fiscal system provides a comparatively low rate of return for upstream investors, combined with a relatively high government take. For a producer exporting all of its output, for example, IHS Markit calculates that the overall tax take varies from about 18% when oil is USD 30/bbl, up to 54% when the price is USD 100/bbl.

Important taxes include:

- signature bonus
- Mineral Resources Extraction Tax, based on gross revenue, with the rate (0.5-18%) depending on production volume and whether the oil is for export or the domestic market
- export duty, which is zero if the world oil price is below USD 25/bbl, sliding from 5-12% as the world price climbs to USD 40, staying at that rate until a world price of USD 50, then escalating again with the world price. (Exports to Eurasian Economic Union [EAEU] countries are exempt from export duty).

Other significant taxes include an excess profits tax, excise taxes, value-added tax (VAT), land and property taxes, and environmental fees and charges.

IHS Markit notes that development costs in Kazakhstan are also relatively high. It estimated that the required break-even world price for oil for a typical onshore expansion project was around USD 57/bbl, and about USD 64/bbl for a typical new offshore project. Total costs for a sample group of Kazakh producers were USD 30/bbl to USD 35/bbl during 2014-2019. About half of this consisted of taxes, and a quarter was transportation costs. The remaining quarter was operating costs, about a third of which consisted of wages and other costs related to employees (Kazenergy, 2021).

Local content requirements for oil and gas companies historically have been fairly strict. While the end of the transition period for Kazakhstan's accession to the World Trade Organization on 1 January 2021 ended many of these requirements for contracts signed after 2011, most are still applicable for contracts signed prior to this, notably including the "big three". For example, well over 50% of the managers in most of the major international projects are Kazakhs.

IHS Markit estimates that Kazakh companies represented approximately 44% of the local oilfield services market in 2020. However, an important barrier to developing local services has been limited demand outside the "big three" projects.

Auctions

According to a government decision in 2020, all auctions for new acreage are to be held online, in order to increase transparency. Each bidder participating in the auctions must have a Kazakh subsidiary (Kazenergy, 2021). The first two online electronic auctions were organised by the Ministry of Energy in December 2020 and April 2021 but did not attract any international majors. Some 60 onshore blocks originally had been offered, but deals were signed for only 15 blocks with several small local producers and offshore entities. In May 2021, the Ministry of Energy announced plans to amend the rules for future auctions, and to hold a third auction for November 2021 (Kazenergy, 2021). Originally, no more than two auctions were to be allowed each year, but this restriction reportedly may be removed. Another proposed change is the granting of development rights to the second-highest bidder in case the winner declines (Kazinform, 2021c).

Model contract

The government is currently developing a model contract in an effort to make fiscal terms for new projects more predictable and transparent. It would not be used for existing projects but only for new ones. The government is working on this in consultation with a working group of the Kazakhstan Council of Foreign Investors, an advisory body set up by the government in 1998.

According to the Ministry of Energy (MoE, 2022a), the new model contract is expected to include the following regulatory and fiscal terms:

- stability of contract terms and fiscal regime;
- international arbitration for dispute resolution;
- exemption from property tax for the duration of the contract;
- exemption from Export Customs Duty on crude oil; and
- increase in the depreciation limit for costs after the start of production.

As of May 2022, the model contract had not yet been adopted.

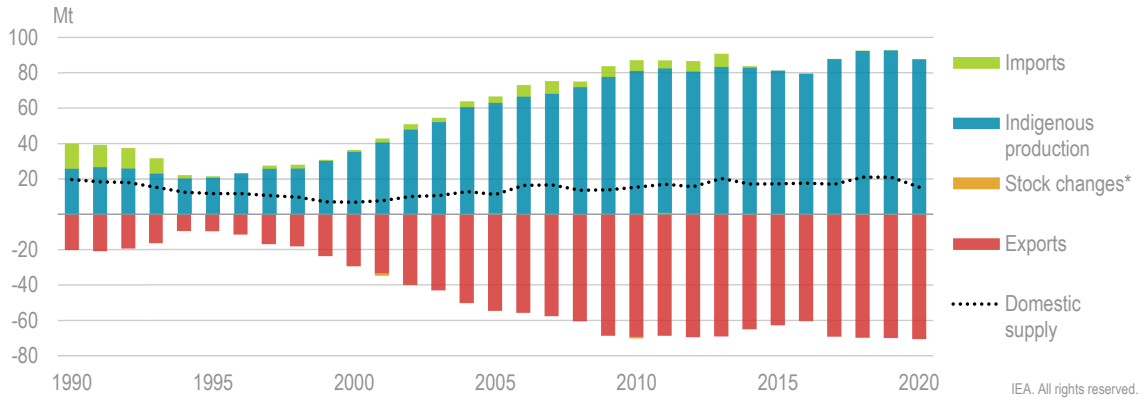
Trade

Crude oil trade

Kazakhstan exports nearly 80% of the crude oil it produces. Export volumes, including gas condensate, increased from around 10 Mt in 1995 to around 70 Mt in 2020. In response to lower world demand during the Covid-19 pandemic, exports in 2021 were expected to be around 68 Mt (Kazinform, 2022b).

Traditionally, the main markets for Kazakhstan's crude exports have been the United States, the European Union and Southeast Asia. The Russian invasion of Ukraine in March 2022 significantly impacted Kazakh oil exports.

Figure 3.3 Oil trade relative to production, 1990-2020

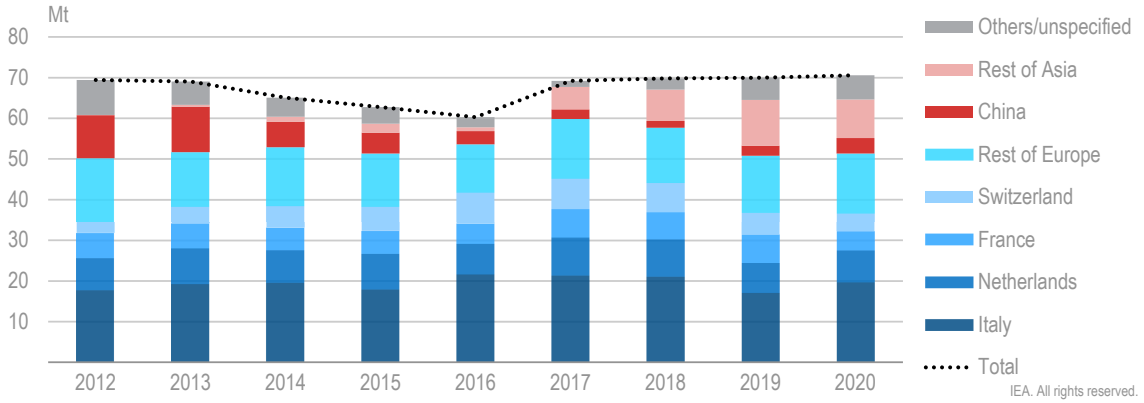


Most oil production is exported.

* Not visible at this scale.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 3.4 Oil exports by country, 2012-2020



The European Union is the main destination for Kazakhstan's oil exports.

Note: Breakdown data available since 2012.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 3.5 Oil and gas pipelines

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: SEEPX Energy Limited (2021).

Oil export infrastructure

The main oil export routes include pipelines, as well as sea and rail routes. Most export routes traverse Russia.

The **CPC** is Kazakhstan's main oil export route. It has a current capacity of 67 Mt per year and transports oil from western Kazakhstan over 1 500 km to the Yuzhnaya Ozereyevka terminal near Novorossiysk on Russia's Black Sea coast. A de-bottlenecking project aims to increase capacity to approximately 72.5 Mt per year, or to 78 Mt with the addition of drag-reducing agents (Kazenergy, 2021).

In 2021, the CPC carried 60.7 Mt of oil, of which 53 Mt (87%) came from the Kashagan, Tengiz and Karachaganak fields in western Kazakhstan (Eurasianet, 2022a). The CPC picks up Russian oil along the way; typically, about 10% of oil carried by the CPC is Russian.

The CPC has over ten shareholders, the largest of which are Russia (24%), KMG (19%), Chevron Caspian Pipeline Consortium Company (15%) and LukArco (12.5%) (CPC, 2021). The CPC is the only pipeline traversing Russian territory that is not fully owned by Russia's Transneft.

Despite the fact that the CPC passes through Russia, the United States and the EU have exempted Kazakh oil exports via CPC from sanctions they imposed on Russia over the war in Ukraine. However, the Moscow-based management of CPC announced in March 2022 that the route would be largely unusable by Kazakh exporters anyway because of damage allegedly caused by storms to loading infrastructure at the marine terminal, further

warning that there may be difficulties obtaining necessary parts for fixing the relevant infrastructure because of sanctions. Storage tanks at Novorossiysk reportedly have the capacity to hold eight days' worth of CPC throughput. Since Kazakhstan does not have sufficient alternative export capacity, however, once these tanks become full, the country's main oil export projects need to start curtailing output (Eurasianet, 2022b). The CPC was finally able to begin operating at normal capacity again from 25 April 2022, after a month of inactivity, however the Western partners in the CPC reportedly were never able to independently verify the storm damage (Eurasianet, 2022c).

Even before the closure of the port, oil tankers stopping at Novorossiysk reportedly were having to obtain war-risk insurance because of proximity to the fighting in Ukraine (Novorossiysk is 200 km from Mariupol). This effectively raised the price of crude arriving via the CPC and consequently lowered demand. Moreover, one of the main destinations of CPC oil has been Odessa (where oil can enter pipelines to Europe), a port city that has been effectively closed since March 2022, when it came under siege by the Russian navy.

In June 2022, the EU and United Kingdom decided to ban the provision of insurance for ships carrying Russian oil as a way to further impede Russian oil exports, similar to the successful insurance bans used against Iran a decade ago. Without insurance, tankers risk being turned away from most ports. However, there is a risk that insurers will err on the side of caution if there are doubts about the provenance of the oil, an approach that potentially could impact shipments from other countries, including Kazakhstan (FT, 2022). It is perhaps to avoid such doubts that KMG began a process in June 2022 to re-brand Kazakh oil transiting Russia's Transneft system, accompanied by an information campaign. Whereas such oil previously has traded under the Urals or Siberian Light monikers, commercial documents reportedly will now refer to a new blend, to be called KEBCO, for Kazakhstan Export Blend Crude Oil (S&P Global, 2022).

Other important oil export pipelines via Russia include the **Atyrau-Samara** line, which connects Kazakhstan to export points on the Baltic and Black Seas via the Transneft system. This line normally handles up to a quarter of Kazakhstan's oil exports.

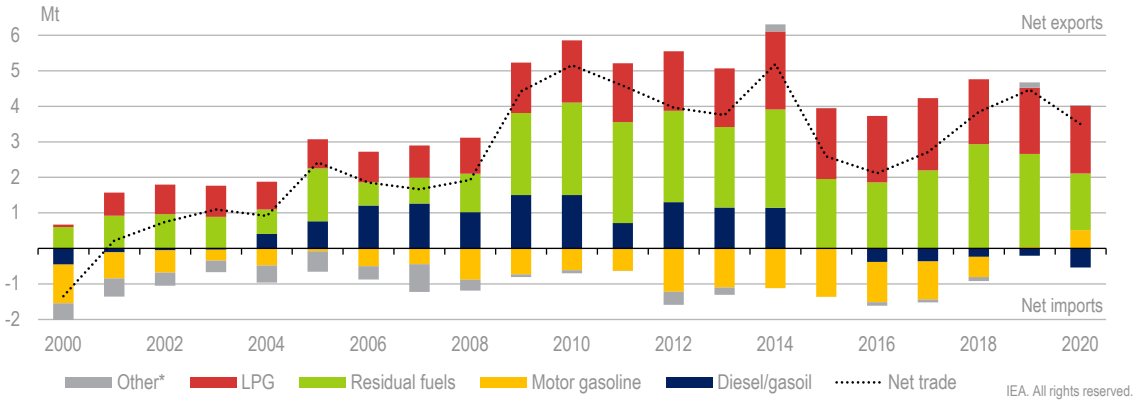
The **Atasu-Alashankou** oil pipeline to China is owned 50-50 by Kazakhstan's QazaqGaz and the CNPC subsidiary, China National Oil and Gas Exploration and Development Corporation (CNODC). It is capable of carrying up to 20 Mt per year, though is effectively currently limited by the capacity of the Kenkiyak-Atyrau pipeline. In 2020, Kazakhstan shipped only 0.5 Mt through this line, which also carries Russian crude to China, and in 2021 around 1 Mt. Although technical constraints exist, another factor reportedly has been low prices offered at the Chinese border.

Some exports also take place via Kazakhstan's Caspian Sea port of **Aktau** to Baku, Azerbaijan, where oil can enter the Baku-Tbilisi-Ceyhan pipeline to Turkey's Mediterranean coast. In 2021, this 50 Mt line reportedly was only at 55% of capacity, in theory leaving space to accommodate around one-third of the CPC's annual exports. However, such a multimodal route is logistically more complicated and hence more expensive than the CPC for Kazakh exporters. Moreover, in January 2021 Turkey raised the transit fee across the Turkish section from USD 0.55 to USD 1.50-2.00 per barrel (Eurasianet, 2022b). The Ministry of Energy, together with KMG and KazTransOil, reportedly has been reviewing the possibilities for expanding the use of this route.

Oil product trade

After the refinery refurbishment programme, completed in 2018, Kazakhstan became self-sufficient in most oil products.

Figure 3.6 Oil product trade by product, 2000-2020



* Includes aviation fuels, other kerosene, lubricants, bitumen, petroleum coke and unspecified oil products.
Note: LPG = liquefied petroleum gas.

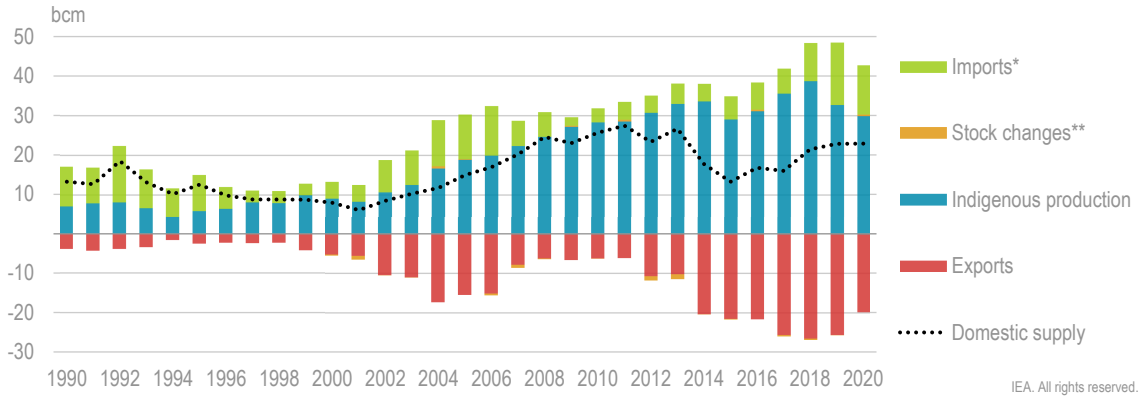
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Kazakhstan has periodically imposed bans on the export or import of various oil products in response to temporary mismatches between domestic demand and available product slates from the country's refineries. For example, the Covid-19 pandemic led to falling demand for certain products, while relatively low domestic prices have significantly increased demand for some products from outside the country, notably for diesel by long-haul truckers. Smuggling has also reportedly been a problem. This led to a major resumption of diesel imports from Russia during 2020 and 2021. While Kazakhstan could have increased refinery runs to make more diesel available, this would have created a glut in other products, for which Kazakhstan possesses limited storage.

Gas trade

Gas trade statistics for Kazakhstan are complicated by large amounts of transit and swaps, related in part to the fact that the country's gas transportation system was originally designed as part of a wider network for the Soviet Union. In addition, conflicting figures are reported by different authorities, such as the pipeline operator, customs authorities and the statistical agency.

Figure 3.7 Natural gas supply, 1990-2020



Natural gas demand almost doubled between 2000 and 2020 (+192%).

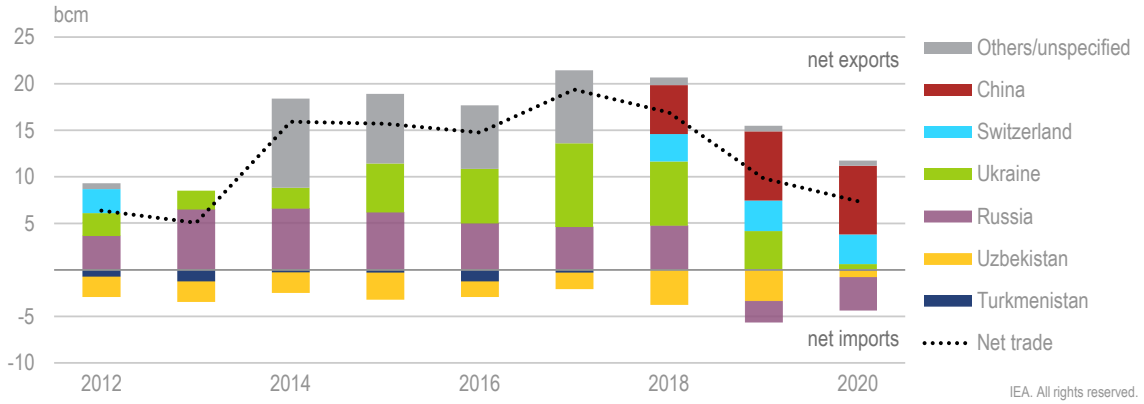
***** By default, transit of natural gas should not be reported as trade. The relatively large volumes of imports are (mostly) explained by the agreement between Kazakhstan and Russia to send raw natural gas from the Karachaganak field in Kazakhstan to the Orenburg gas processing plant in Russia. Some of the gas is returned directly from Orenburg, some as swaps from elsewhere in Russia. As a result, the BNS and the ministries can quote very different figures for the trade, therefore it is important to pay attention to the source for the data.
** Not visible at this scale.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

According to customs data, Kazakhstan exported 18.8 bcm in 2020, though the amount was 16.7 bcm according to QazaqGaz's operational data (Kazenergy, 2021). The data from the BNS show exports of 19.8 bcm and imports of 12.4 bcm, resulting in net exports of 7.4 bcm. QazaqGaz reports that its predecessor company, KazTransGas, exported 10.7 bcm (38%) of processed gas in 2020. About 7.4 bcm of this went to China under a 2018 agreement with PetroChina International to export up to 10 bcm per year (QazaqGaz, 2022a). Most of the rest went to Russia (KTG, 2021). In addition, under an arrangement dating from Soviet times, Kazakhstan sends raw gas across the border for processing at Russia's Orenberg refinery. This also contributes to the challenges in interpreting the trade figures from various sources.

Historically, Kazakhstan has imported significant amounts of gas from Uzbekistan to its relatively densely populated south, which until a few years ago was isolated from the country's main gas-producing region in the west. Such imports have decreased since completion of the internal Beyneu-Bozoy-Shimkent pipeline, which also facilitates shipments of gas to China. Nevertheless, imports from both Uzbekistan and Turkmenistan in the south, and from Russia in the north, are expected to continue helping Kazakhstan meet rising domestic demand (Kazenergy, 2021), though Uzbekistan has plans to phase out gas exports by 2035.

Figure 3.8 Natural gas trade by country, 2012-2020



Exports to China have increased since 2018.

Notes: Breakdown data available since 2012.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Kazakhstan is also a major gas transit country. QazaqGaz subsidiary JSC Intergas Central Asia (ICA) reported 30.8 bcm in international transit in 2020 (KTG, 2021). This consisted primarily of Turkmen deliveries to China via the 55 bcm Central Asia-China Gas Pipeline (CAGP), the Kazakh portion of which was inaugurated in 2009. It also includes Uzbek deliveries to China on this route, as well as Uzbek deliveries to Russia via the Central Asia-Centre (CAC) pipeline (KTG, 2021).

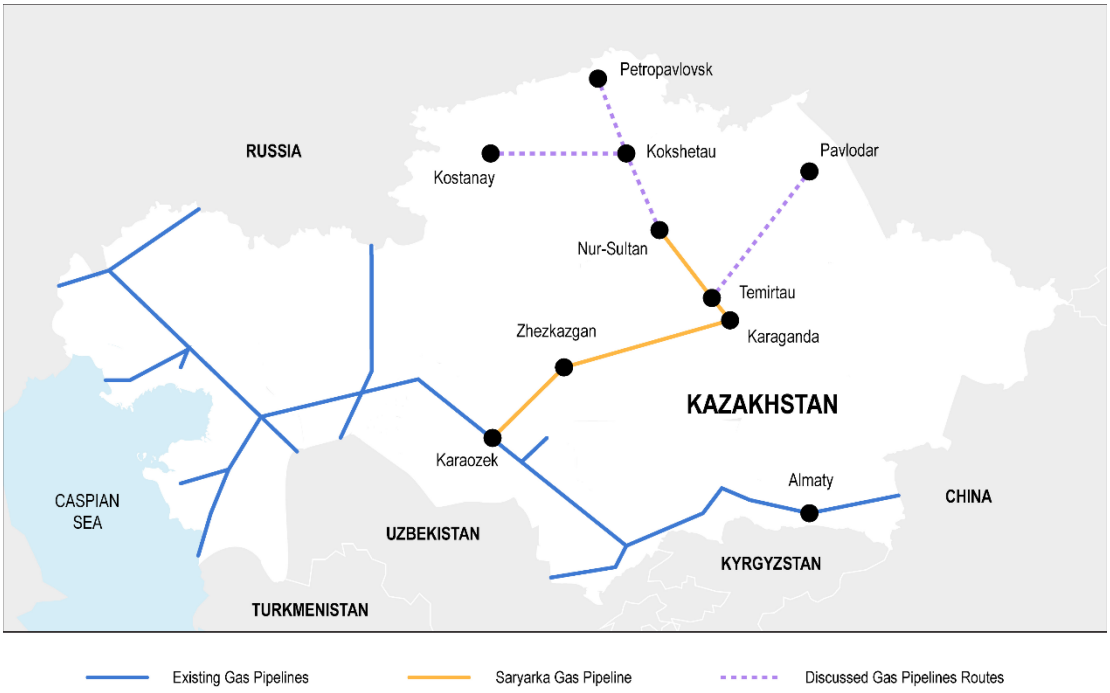
Kazakhstan is a member of the Eurasian Economic Union (EAEU), which is planning to launch a common gas market in 2025 following a decision in May 2016 by the Supreme Eurasian Economic Council and an agreement signed in 2019 by its member countries. (Other members of the EAEU are Armenia, Belarus, Kyrgyzstan and Russia.) A final agreement to form the common gas market is expected to be made by member countries in 2022. Members are also drafting common trading and access rules, which are expected to include provisions for third-party access.

The Kazakh government's Concept for the Development of the Fuel and Energy Complex notes that the EAEU can have an initial positive impact for consumers. However, it cautions that Gazprom has already monopolised the gas markets of all other EAEU member states. It warns that Kazakhstan's current monopoly operator could be squeezed out of the market and effectively replaced by a "new monopolist" (RoK, 2020).

Gas export and transit infrastructure

Much of Kazakhstan's gas transportation system is used for the transit of Uzbek and Turkmen gas to Russia and China. Transit lines to Russia notably include the **CAC** pipeline (54 bcm/year capacity), which runs 3 544 km in a north-westerly direction through western Kazakhstan and links Turkmenistan and Uzbekistan to the Russian pipeline system. The **Makat-North Caucasus** pipeline (24.4 bcm capacity) branches off from the CAC at Makat and runs westward north of the Caspian Sea into Russia. And the **Bukhara-Urals** pipeline (26 bcm/year capacity) runs two parallel lines from Uzbekistan northward 1 175 km across western Kazakhstan to join Russia's Urals system.

Figure 3.9 Gas transportation infrastructure in Kazakhstan



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Aiymgul Kerimray, adapted from Tengrinews (2020).

The Chinese-financed **CAGP** stretches from Turkmenistan across Uzbekistan and Kazakhstan eastward to Xinjiang in western China, covering 3 544 km on Kazakh territory. Its 55 bcm/year capacity is used primarily to export Turkmen gas to China, though it also carries Uzbek gas and up to 10 bcm per year of Kazakh gas. It is one of the largest investment projects in Kazakhstan's oil and gas sector (KTG, 2021).

The isolated **Zaysan-Jeminay** pipeline in north-eastern Kazakhstan, operating since 2013, brings small amounts of Kazakh gas (0.3 bcm in 2019) from Zaysan to an LNG plant in Jeminay, China (Kazenergy, 2021).

The CAGP is connected at Shimkent to the new 1 450-km **Beyneu-Bozoy-Shymkent (BBS)** line, which was also partly financed by China and started operations in 2018. The BBS allows gas from western Kazakhstan to be exported to China while also filling a major gap in Kazakhstan's domestic network by connecting population centres in the south (KTG, 2021), running through the Mangistau, Aktobe, Kyzylorda and Turkestan oblasts.

The **Bukhara-Tashkent-Bishkek-Almaty** pipeline (5.8 bcm/year capacity) runs 1 585 km in two parallel lines along Kazakhstan's south-eastern border and sends Uzbek gas east to Kyrgyzstan. Along the way it helps supply Kazakhstan's largest city, Almaty.

The **Okarem-Beyneu** pipeline (7.2 bcm/year capacity) brings gas from fields in western Turkmenistan through 470 km of south-western Kazakhstan to meet the CAC line at Beyneu.

Since QazaqGaz's gas pipeline network used to be part of an integrated system for the Soviet Union, several sections of Russian and Uzbek "internal" lines traverse Kazakh

territory in places. There is also a long-standing agreement under which Kazakhstan sends about 10 bcm per year of raw gas (mainly from Karachaganak) across the border through the **Soyuz-Orenburg-Novopskov** line (16 bcm/year capacity)[6] to Russia's Orenburg refinery for processing.

Demand

Oil demand

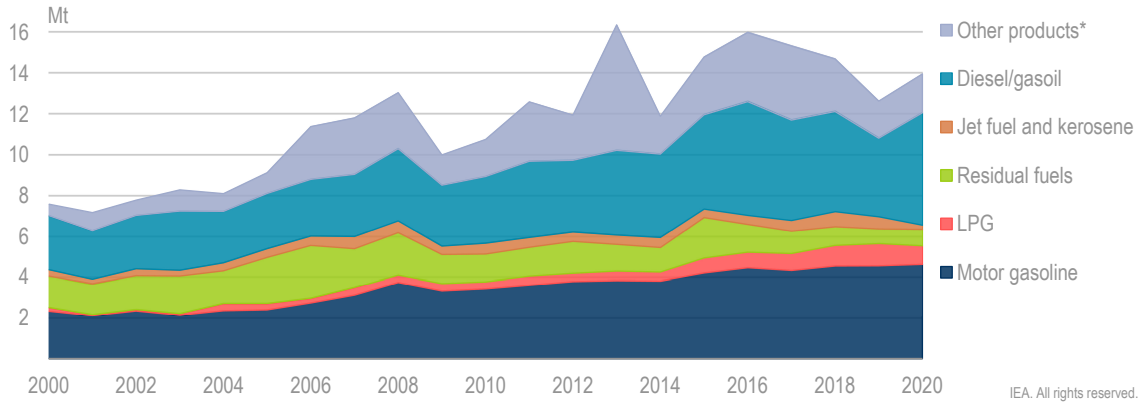
Domestic demand for oil was 14.0 Mt in 2020 (309 kb/day), equivalent to approximately 16% of Kazakhstan's crude production.

Diesel fuel, which is consumed mainly in transport, agriculture and heavy industry, represented about 44% of refined-product demand in 2020. Motor gasoline, consumed primarily in road transport, covered 37%. LPG, consumed mainly in the residential sector represented about 7%. The remainder of the consumption consisted of residual fuels (6%), jet fuel and kerosene (2%), and non-energy oil products such as bitumen and lubricants (5%).

The transport sector represented 45% of Kazakhstan's oil product demand in 2020. Some 64% of this was for motor gasoline, 19% was for diesel and 3% was for aviation fuel. With the exception of aviation fuel, almost all oil products consumed in the transport sector were for road transport.

The residential sector accounted for 16% of the country's oil product demand in 2020, although some 66% of this was diesel that probably should be reported under consumption by the transport sector,[7] while 34% was LPG for cooking.

Figure 3.10 Oil consumption by product, 2000-2020



Oil product consumption mostly consists of transport fuels.

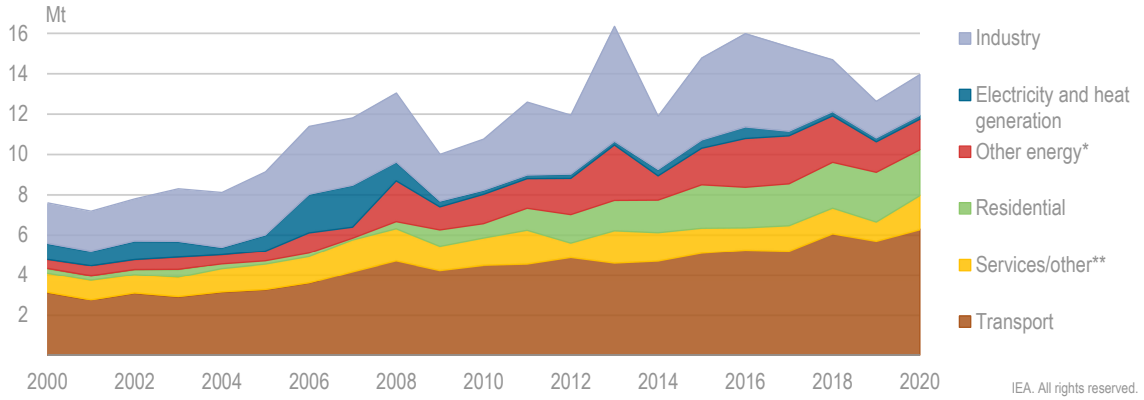
* Includes direct use of crude oil, aviation gasoline, gasoline-type jet fuel, white spirit, lubricants, bitumen, petroleum coke and unspecified oil products.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

[6] Most capacity and length figures are from Table 4.5 of Kazenergy (2021).
[7] According to the Household Energy Consumption Survey conducted in 2018, only 5 households out of the 21 000 surveyed were using diesel fuel (IEA, 2020a).

Industry represented 15% of demand for oil products in 2020, particularly in the iron and steel, mining and quarrying, and construction sectors. About 47% of the product demand in this sector was for diesel, and 23% was for fuel oil. Approximately 19% was for bitumen, primarily for road construction.

Figure 3.11 Oil consumption by sector, 2000-2020



Transport is the largest consumer of oil products.

* Includes use in coal mines, oil and gas extraction, blast furnaces, oil refineries and unspecified energy industries as well as distribution losses.
** Includes commercial and public services, agriculture, forestry and unspecified consumption.

Note: Spike in industry consumption for 2013 is linked to alleged direct use of crude oil in oil and gas extraction
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

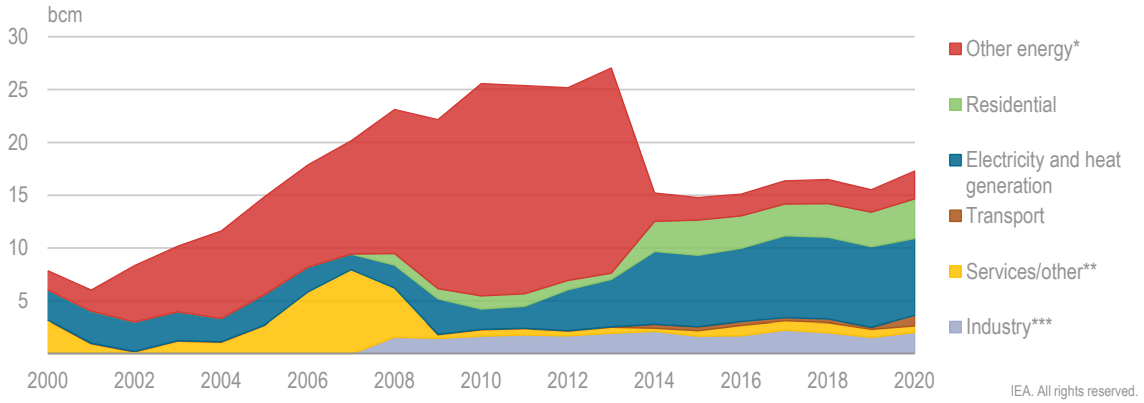
Quarantine measures during the Covid-19 pandemic sharply cut demand for oil products in 2020. For example, in April 2020, year-on-year demand for diesel and gasoline was down approximately 40%, while demand for aviation fuel fell 70% (Kazenergy, 2021).

Gas demand

Over the past ten years, gas consumption in the domestic market grew by over 90%, from 9 bcm in 2010 to 17 bcm in 2020 (MoE, 2021a). According to government forecasts, domestic consumption is expected to reach 25.7 bcm by 2025 and 30.2 bcm by 2030 (Kazinform, 2021d).

Electricity and heat production accounted for 42% of domestic gas demand in 2020, followed by the residential sector (22%), own use by the oil and gas industry (15%), other industry (12%), services/other (4%), and transport (6%).

Figure 3.12 Natural gas demand by sector, 2000-2020



Gas consumption is growing in power and heat generation and the residential sector.

* Includes oil and gas extraction, own use in electricity and heat production, distribution losses, and unspecified energy industry consumption; until 2014 the official data incorrectly include large volumes of raw gas.
** Includes commercial and public services, agriculture, forestry and unspecified consumption.
*** Includes non-energy consumption.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Gasification

Overall, the level of gasification increased from 30% of the population in 2013 to 53% in 2020, reaching approximately 9 million households, while the number of gasified enterprises doubled from 23 725 to 51 285 (KTG, 2021). By the end of 2021, the Minister of Energy announced that the level of gasification had reached 55%, exceeding 10.3 million households (Kazinform, 2021e).

The country is effectively four regional gas-consuming markets (Kazenergy, 2021). Over 90% of the population is connected to the grid in the western, gas-producing region, which consists of Mangystau, Atyrau and West Kazakhstan oblasts. The north-western region, including Aktobe and Kostanay oblasts, is also supplied from nearby production. The southern region, including Turkestan, Shymkent, Almaty, Zhambyl and Kyzylorda oblasts, historically imported most of its gas from Uzbekistan, but was connected to the gas-producing west of the country through the BBS pipeline in 2019.

The SaryArka pipeline, which recently began delivering gas to the capital, Nur-Sultan, will similarly be important for gasifying parts of the north. However, as an alternative to extending SaryArka, the government is also considering supply via new pipelines from Russia, particularly for Petropavlovsk, Kokshetau, Ust-Kamenogorsk, Semey and Pavlodar (Kazinform, 2021f). Additional important lines to be constructed as part of the government's gasification plans include second lines for the BBS and Beyneu-Zhanaozen pipelines, and a third line for the Bukhara-Urals line (Kazinform, 2021g).

Gasification is set to continue in line with the General Scheme of Gasification for 2015-2030, which calls for 56% of the population to have access by 2030 (GoK, 2014). However, the Minister of Energy announced at the end of 2021 that he now expected it to reach 65% by 2030, that natural gas would be provided to a total of 11 million people by 2025 and 13.5 million by 2030, in particular due to the expected gasification of the northern and eastern regions of the country (Kazinform, 2021g).

The market for natural gas as a transport fuel is growing. There are currently 16 filling stations for compressed natural gas (CNG) in the country, which sold 42.2 million cubic metres (mcm) of CNG in 2020, up 28% from 2019 (KTG, 2021). However, only around 0.1% of light vehicles had engines fuelled by CNG as of the beginning of 2021 (Kazenergy, 2021). An Action Plan for 2019-2022, approved by the government in November 2018, provides for the construction of up to 100 CNG and LNG filling stations. The government aims for gas to account for at least 50% of motor fuel consumption by 2030 in public transport road transport in Almaty, Nur-Sultan and Shymkent, and at least 30% in other regional centres (MoE, 2021a).

Domestic operations and infrastructure

Oil transportation, refining and storage

KazTransOil, a subsidiary of KMG, owns the main crude oil pipeline network, which is used for exports and for bringing oil from producers to Kazakhstan's several refineries and bitumen plants. The oil pipeline network is 5 372 km and transported 73.2 Mt of oil and condensate in 2020 (KMG, 2020).

Kazakhstan's main refineries are in Atyrau, Pavolodar and Shymkent. All are owned by KMG, though China's CNPC is also a shareholder in the Shymkent plant. In 2018, Kazakhstan completed a comprehensive programme to modernise its three main refineries, raising total annual capacity from 14.2 Mt to 17.5 Mt and significantly increasing the share of light oil products, particularly gasoline and jet fuel (MoE, 2021a). Refinery throughput in 2020 was 15.8 Mt, down 7.2% from 2019 (Kazenergy, 2021), in large part due to decreased demand resulting from the Covid-19 pandemic.

The current financial arrangement in the refinery sector dates from 2016 and is designed to ensure a profit for refiners to help pay off loans for recent investments in modernisation. Crude producers sell to traders at the refinery gate, and traders pay refineries a processing fee for their services, then sell the resulting product to other traders or wholesalers, leaving the refineries with little risk (Kazenergy, 2021).

Historically, the price paid for crude at the refinery gate has been significantly below the world market price, presumably because of the limited ability of certain domestic crude producers to export. For example, the price of oil entering Kazakhstan's refineries during 2014 through 2019 reportedly was about 40% of the world price on average. This rose to around 47% of the world price during the second half of 2020, but fell again to 37% during the first half of 2021 (Kazenergy, 2021).

At a briefing in February 2022, the minister of energy announced that an oil product reserve of 200 000 tonnes would be created, though the makeup of such reserves was not specified (Kazinform, 2022c). In a speech in March 2021, the vice-minister of energy noted that the country had on hand enough reserves of gasoline to last 25 days (Tengrinews, 2021).

Retail oil market

Kazakhstan has about 3 000 filling stations, primarily privately owned. The main players in the retail market include Petro Retail LLP, SinoOil LLP, Helios LLP and Gazprom Neft-Kazakhstan LLP.

Although the government notes that it has not regulated prices for gasoline since 2015, and for diesel fuel since 2016 (Tengrinews, 2021), the 2021 Kazenergy report notes that the refining sector and product markets are "highly administered" (Kazenergy, 2021), starting with the low internal price for crude. In practice, prices for oil products in Kazakhstan are significantly lower than they are in neighbouring countries. This apparently has led to smuggling as well as to a large growth in diesel fuel consumption by long-haul trucks. The volume of diesel fuel produced in Kazakhstan in 2021 was about 4.9 Mt, the highest since 2015. However, consumption for the five months of that year between May and September was up by 480 000 tonnes compared with the same period in 2020, and by 246 000 tonnes compared with the same period in 2019 (MoE, 2021b). This situation led the country to start importing significant amounts of diesel fuel from Russia again in 2021.[8]

Following the unrest in January 2022 that began with protests about fuel price rises, maximum prices were set for motor fuels and lubricants for a period of six months. Depending on the region, diesel will cost between KZT 220 (Kazakhstani tenge) to KZT 260 per litre, depending on the region, while AI-92 gasoline may be sold for no more than KZT 182 and AI-95 gasoline for no more than KZT 215 (Kazinform, 2022d).

Many vehicles in Kazakhstan, including private cars, run on LPG,[9] particularly in the oil-producing western part of the country where the share of vehicles using LPG is estimated to be 70-90% (Kumenov and Lillis, 2022). A doubling in the price of highly subsidised LPG from KZT 60 per litre (about USD 0.14) to KZT 120 at the beginning of 2022 reportedly was the spark for the largest unrest that the country had witnessed since independence. Relatively peaceful protests that began in the western town of Zhanaozen in Mangystau oblast quickly spread to other parts of the country. Unrest in Nur-Sultan and Almaty became particularly violent, leading President Tokayev to call upon the Russian-led troops of the Collective Security Treaty Organization (CSTO) to help restore order.[10] While it appears that the protests gained significant momentum from grievances besides the fuel price hike, and according to the government were quickly hijacked by the agendas of outside political forces, they do underline the politically sensitive nature of energy prices in the country.

Box 3.1 Liquefied petroleum gas prices

Kazakh LPG reportedly costs around KZT 80 per litre to produce, but until 1 January 2022, the allowed retail price had only been KZT 60. This led to shortages, while giving refineries few incentives to upgrade facilities to produce additional LPG. Since LPG prices in neighbouring countries are significantly higher than those in Kazakhstan, smuggling reportedly has been a problem. In order to address these issues, Kazakhstan began phasing in electronic trading of LPG in 2019, culminating in wholesale prices being completely determined by the market as of 1 January 2022. However, the retail price rise apparently was not phased in but occurred abruptly. The Minister of Energy has also

[8] See for example https://www.gov.kz/memleket/entities/energo/press/news/details/270728?lang=ru.

[9] LPG is a refinery product that is mainly a mixture of propane and butane. It is usually sold in pressurised containers and most commonly used for cooking.

[10] President Tokayev requested assistance from the CSTO on 5 January. Around 2 000 soldiers began arriving shortly afterward, mostly from Russia, but also from CSTO countries Belarus, Armenia, Kyrgyzstan, and Tajikistan. CTSO troops reportedly focused on guarding key infrastructure and completed their withdrawal from Kazakhstan by 20 January (CACI Analyst, 2022b).

blamed retailers for the sharp increase, noting that their markup of 25-50% was "higher than expected [and] gives us grounds to suspect possible price speculation among filling stations". Kazakhstan's anti-monopoly agency reportedly began investigating, and filling stations soon lowered their prices for LPG to KZT 85 to KZT 90 per litre. In Mangystau oblast, where protests began, officials even promised to cut the retail price to KZT 50, i.e. lower than the originally subsidised price (Eurasianet, 2022d).

EAEU common market for oil products

As a member of the EAEU, Kazakhstan has agreed to form a common market for oil and petroleum products to complement those markets currently being formed for gas and electricity. The EAEU oil and petroleum market is expected to be launched in 2025, though member countries have yet to work out many of the details. (The other EAEU members are Armenia, Belarus, Kyrgyzstan and Russia.)

Gas transportation, processing and storage

KMG subsidiary QazaqGaz (prior to 2022 known as KazTransGas) owns and operates the country's main gas transportation and distribution networks. QazaqGaz is also a small gas producer, though its main source of gas is its pre-emptive right under Kazakhstan's single-buyer model to purchase from the country's other producers, according to government decree No. 914 of 5 July 2021 (MoE, 2021a).

QazaqGaz's Unified Gas Supply system includes over 20 000 km of main lines for gas transportation. It employs 42 compressor stations and 238 pumping units (KTG, 2021) that provide an annual throughput capacity of 228 bcm, including for international transit and export. Most of this network is in the western, oil-and-gas producing part of the country, where some 20 subsoil users are connected. The main gas transport lines are managed by QazaqGaz subsidiary ICA, including the lines that facilitate international transit.

The **BBS** gas pipeline links the gas-producing west of the country with population centres in the south. It also facilitates exports of Kazakh gas to China through its connection with the CAGP at Shymkent. The BBS pipeline began operations in 2018. Capacity on BBS was increased from 10 bcm/year to 13 bcm/year in 2019, and to 15 bcm/year in 2020 by the construction of additional compressor stations (KTG, 2021).

The **Saryarka** pipeline (capacity around 4.5 bcm/year) branches off from the BBS at Karaozek, near the middle of the country, and runs North to the capital, Nur-Sultan. There are plans to extend it to Kokshetau and Petropavlovsk to help gasify the north of the country (Kazenergy, 2021). (See also the overview of the main transit pipelines above).

QazaqGaz's predecessor, KazTransGas, transported 57.8 bcm in 2020, down from 73.0 bcm in 2019. Most of the fall was due to a decline in international transit, which was 40.2 bcm in 2019 but only 30.8 bcm in 2020. Transport of Kazakh export volumes was also lower in 2020, down from 19.1 bcm in 2019 to 12.7 bcm. In contrast, transport of gas for the domestic market increased slightly in 2020 to 14.3 bcm, up from 13.7 bcm in 2019.

QazaqGaz also operates over 56 000 km of distribution networks (KTG, 2021).

QazaqGaz reportedly has been losing money on the domestic gas market, but more than covering such losses through gas export sales and transit operations, primarily to China.

It has used its export profits to implement government plans to expand domestic gas transportation and distribution networks in line with the General Scheme of Gasification (MoE, 2021a).

Gas processing

Kazakhstan has a total gas processing capacity of just over 30 bcm per year. Most of this is provided by its five main gas processing plants:

- Kazakh gazopererabativayushchiy zavod (GPZ) in Mangystau oblast (2.9 bcm/year throughput capacity)
- TCO GPZ at the Tengiz/TCO site in Atyrau oblast (9.2 bcm)
- Zhanazhol GPZ, owned by CNPC and AktobeMunayGaz (7.0 bcm)
- Kashagan GPZ at the Kashagan site in Atyrau oblast (6.0 bcm, currently being expanded)
- Zhaikmunay GPZ in West Kazakhstan oblast (4.2 bcm).

An additional 2 bcm/year of capacity is expected to be constructed at the Kashagan plant by 2030. Kazakhstan also sends approximately 10 bcm per year across the border to Russia's Orenburg plant. According to Kazenergy, total processing capacity, including that of Orenburg, appears adequate for the volumes of gas expected over the coming decade. However, more capacity may be needed to process "sour" gas, i.e. gas with a high sulphur content. Much of Kazakhstan's gas falls into this category, making it relatively expensive to treat (Kazenergy, 2021).

Gas storage

QazaqGaz manages three underground gas storage (UGS) facilities, with a total active capacity of around 6.5 bcm (QazaqGaz, 2022b). The Bozoy UGS in the Aktobe region has an active storage volume of around 5.9 bcm, up from 4 bcm following a major reconstruction in 2021. Housed in a depleted gas field at a depth of 350 metres to 400 metres, Bozoy is one of the largest gas storage facilities on the Eurasian continent. It contains two separate sections, which came into operation in 1974 and 1982, and is equipped with a gas drying unit to eliminate water vapour from the stored gas. Since the commissioning of the BBS pipeline from western Kazakhstan, Bozoy has played an important role in handling seasonal fluctuations for gas consumers in Aktobe, Kostanay, Turkestan, Zhambyl and Almaty oblasts (QazaqGaz, 2022b).

The other two gas storage facilities are the Poltorataskoye UGS in the Turkestan region (0.35 bcm) and the Akyrtobe UGS in the Zhambyl region (0.3 bcm) (MoE, 2021a).

Domestic gas market

QazaqGaz's predecessor, KazTransGas, historically has primarily focused on operating the gas pipeline system, but the new company is effectively becoming an integrated gas monopoly. While QazaqGaz produces small amounts of gas itself, its main source is its pre-emptive right to purchase raw and commercial gas from other producers in accordance with government decree No. 914 of 5 July 2021 (MoE, 2021a). For example, in 2020 it signed an agreement with the North Caspian Operating Company (NCOC) for associated gas intake services through 2042 that secure 800 mcm per year from Kashagan beginning in 2023 (KTG, 2021).

Gas tariffs

The Ministry of Energy, in agreement with the Ministry of National Economy, approves maximum wholesale prices for commercial gas in the domestic market separately for each region, taking into account local economic and social conditions. Wholesale prices are determined each year for the period 1 July-30 June (MoE, 2021a). These are the maximum prices that the gas monopoly, QazaqGaz, is allowed to charge large consumers and municipal distribution companies.

KREM sets retail tariffs for natural gas by region and customer type. It does this in accordance with Article 124-6 of the Entrepreneurial Code, based on the maximum wholesale price, distribution tariffs, and allowed trade markups, as approved by order No. 36 of the Minister of the National Economy of 1 February 2017 (MoE, 2021a). It also must take into account rules that allow end-user gas prices to account for only 20% of the prescribed target for inflation (Kazenergy, 2021). In practice, KREM has aimed to keep retail tariffs as low as possible for social welfare reasons.

According to the Law on Gas and Gas Supply, the national operator (currently QazaqGaz) exercises the pre-emptive right of the state to purchase gas from producers. QazaqGaz negotiates gas purchases separately with each producer. The average producer price in 2020 reportedly was USD 48 per thousand cubic metres (kcm), though by June 2021 that had fallen to USD 30.8 (Kazenergy, 2021). In theory, prices paid to producers should follow rules stated in the Law on Gas and Gas Supply that take into account cost of supply. In practice, such prices reportedly are often below the cost of production. The government recognises that such low prices are a deterrent to the development of the gas industry and is considering various solutions, including a more favourable purchase price for producers, as well as the creation of new consumer categories capable of purchasing gas at market prices (Kazinform, 2022e).

Gas pipeline tariffs

KREM also regulates gas pipeline transportation tariffs for domestic supply. KREM sets tariffs for five years, though the pipeline operator has the right to request a tariff review before that time. A new tariff of KZT 2 333.3 (USD 5.70) per kcm for the main gas transportation system run by QazaqGaz subsidiary InterGas Central Asia (ICA) went into effect in December 2020, but was subsequently nearly doubled during 2021 to KZT 4 551 to help cover the additional costs of the SaryArka pipeline (Kazenergy, 2021).

Most gas transportation tariffs in Kazakhstan are “postage-stamp” rates, i.e. they apply the same tariff to all shipments, regardless of point of origin and destination. However, some now take distance into account. For example, at the beginning of 2021 the tariff on the BBS pipeline was changed from a flat rate to KZT 1 200.15 (USD 2.80) per kcm per 100 km. This reportedly significantly helped cut the price of gas to Nur-Sultan via the SaryArka pipeline, which branches off from the BBS (Kazenergy, 2021).

Tariffs for international transit of gas are not regulated by KREM but decided through bilateral negotiations. For example, the tariff for Uzbek and Turkmen gas imported by Gazprom into Russia reportedly was USD 2 per kcm per 100 km in 2020 (Kazenergy, 2021).

Petrochemicals

Kazakhstan produced 359 000 tonnes of petrochemical products in 2020. Due to the small local market, approximately 80% of this was exported, mainly to China and Europe. The country has two main petrochemical complexes. An aromatics plant at the Atyrau refinery, commissioned in 2016, can produce up to 133 000 tonnes of benzene and 496 000 tonnes of paraxylene or xylene annually, though alternatively can produce high-octane gasoline. The Neftekhim LLC plant, situated near the Pavolodar refinery, is able to produce up to 48 000 tonnes of polypropylene per year, as well as methyl tertiary butyl ether (MTBE). There are also plants producing ammonium nitrate fertilizers in Mangystau and Zhambyl oblasts (Kazenergy, 2021).

The government is promoting the development of the petrochemical industry as a way to diversify the economy. Among other policies, it set up a special economic zone in the Atyrau region of western Kazakhstan that provides a number of tax and customs duty exemptions and benefits, in addition to providing proximity to feedstocks. In addition, the government is offering discounted prices for feedstocks for approved petrochemical projects.

A new project being developed by Kazakhstan Petrochemicals Industry Inc (KPI) was reportedly 95% complete by June 2022. Phase 1 will produce about 186 000 tonnes per year of various types of polypropylene for export using domestic propane as feedstock. KMG and Tatneft are currently conducting a front-end engineering design (FEED) study for a butadiene rubber plant that would tie into a facility producing tires for export (MoE 2022, Kazenergy 2021).

Environmental issues

Important environmental issues in the oil and gas sector include the flaring and venting of associated gas and fugitive methane emissions. The main source of upstream GHG emissions come from the on-site use of gas in boilers, process heaters, compressor stations and flaring.

Although routine flaring reportedly has been effectively eliminated in Kazakhstan, approximately 1.5 bcm was flared in 2021, according to the World Bank (World Bank, 2022). Most associated gas that is not sold to QazaqGaz is typically reinjected to help increase oil output. Around 37% of total gross gas production was reinjected in 2020.

Kazakhstan's 2021 National Inventory Report (NIR) to the UNFCCC reported that methane emissions from the energy sector as a whole were 0.54 Mt, significantly down from 1.5 Mt in 2000. IHS Markit comments that data on methane emissions are not generally readily available nor reported uniformly (Kazenergy, 2021). According to data from the IEA's Global Methane Tracker, oil and gas related methane emissions stood at 1.75 Mt in 2021 (IEA, 2022).

In 2014, Norway's Agency for Environmental Protection worked with Kazakhstan's Ministry of Energy and KMG to identify opportunities for reducing methane emissions. As part of this, KMG joined the Global Methane Initiative (GMI) in 2017 (Kazenergy, 2021).

Assessment

Kazakhstan has been successful in attracting the interest of major international investors in its oil and gas sector. However, a worldwide trend towards decarbonisation is making oil and gas companies more selective about developing new acreage. Given Kazakhstan's relatively high development costs for new upstream projects, coupled with long export routes, attracting investment is increasingly expected to depend on ensuring that its fiscal and other policies are internationally competitive.

Diversification of export routes is important for securing the flow of oil and gas to lucrative export markets, which are currently important for the Kazakh treasury. Most of Kazakhstan's oil and gas exports go via Russia. The Russian invasion of Ukraine in 2022 has demonstrated the importance of multiple routes.

Oil exports by tanker across the Caspian Sea to meet the Baku-Tbilisi-Ceyhan pipeline to Turkey's Mediterranean coast may be an important alternative to consider. This route is more expensive than the main Russian routes and may require increasing loading capacities at Kazakh ports such as Aktau, as well as adding to the available tanker fleet. However, building up such a route is likely to be the quickest, most flexible way to increase alternative oil export capacity.

Kazakhstan has been successful in rapidly expanding its domestic gas network. However, increasing gas supplies to meet domestic consumption and export goals appears to be a growing challenge. Producers generally have been reluctant to sell gas to the country's gas monopoly, QazaqGaz, because it is more economic for them to reinject the gas in order to boost oil production. QazaqGaz is limited in the price it can offer producers due to low retail prices set by the regulator. Low producer prices also lower incentives for private operators to develop new gas deposits.

The government would seem to have conflicting incentives regarding how much to pressure companies to sell to QazaqGaz. On the one hand, the government needs companies to sell more gas to help meet its gasification and climate goals. On the other hand, the government derives most of its revenue from oil production, which is boosted by gas reinjection.

As Kazakh domestic demand rises in the coming years, it may be challenging to find additional gas for export. This in turn is likely to undermine the income stream from exports that effectively subsidise domestic consumption and expansion of the domestic gas pipeline network.

The solution would seem to be to offer higher prices to producers in order to give them an incentive to produce more and reinject less. This would also provide greater incentive to search for and develop new major sources of gas. Cost-reflective gas prices would also help Kazakhstan prepare for the 2025 launch of the EAEU common gas market. However, higher prices for producers presumably would lead to higher retail prices for gas, something the government would like to avoid. For social reasons, it would be necessary to introduce any tariff increases gradually, but the longer the government waits to start, the more difficult it will be. KTG's *2020 Annual Report* mentions a meeting between the company and the prime minister in August 2020 at which it was recognised that there was a need to increase the marginal wholesale price of commercial gas by 15% each year between 2021 and 2026.

Domestic oil prices

While the low domestic price of crude has helped keep domestic oil product prices low, it has complicated the ability of Kazakhstan's refineries to attract feedstock, particularly in the face of declining crude production by KMG, since it provides little incentive for international projects to divert crude from more lucrative export markets.

Kazakhstan currently has the lowest prices in the EAEU for most oil products, including gasoline and diesel. Similar to the situation for natural gas, in order to meet the free-trade goals of the EAEU while ensuring sufficient supplies for the domestic market, Kazakhstan presumably will need to further liberalise prices for oil products. Given the social unrest that has followed abrupt rises in product prices, it would need to proceed gradually.

Recommendations

The government of Kazakhstan should:

- Prioritise the diversification of oil export routes.
- Ensure that Kazakhstan's fiscal and other policies remain internationally attractive as oil and gas companies become more selective about developing new acreage.
- Gradually raise prices for gas paid to producers, to ensure that such prices cover the cost of supply and provide sufficient incentive to develop new sources, ideally including for export.
- Allow prices on the domestic market for crude oil and oil products to rise gradually, in order to ensure sufficient feedstock for refineries, combat smuggling and prepare for the introduction of the EAEU common market for oil products.

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4. Coal

Key data

(2020 provisional)

Coal production: 103.3 Mt (44.3 Mtoe), -6.8% since 2010

Coal net exports: 28.8 Mt/11.8 Mtoe (0.9 Mtoe imports, 12.7 Mtoe exports), +7.2% since 2010

Share of coal: 27.9% of domestic energy production, 49.7% of TES, 67.3% of electricity generation, 21.6% of TFC

Coal consumption: 32.2 Mtoe (electricity and heat generation 68.7%, industry 16.5%, residential 11.7%, others 3.2%)

Overview

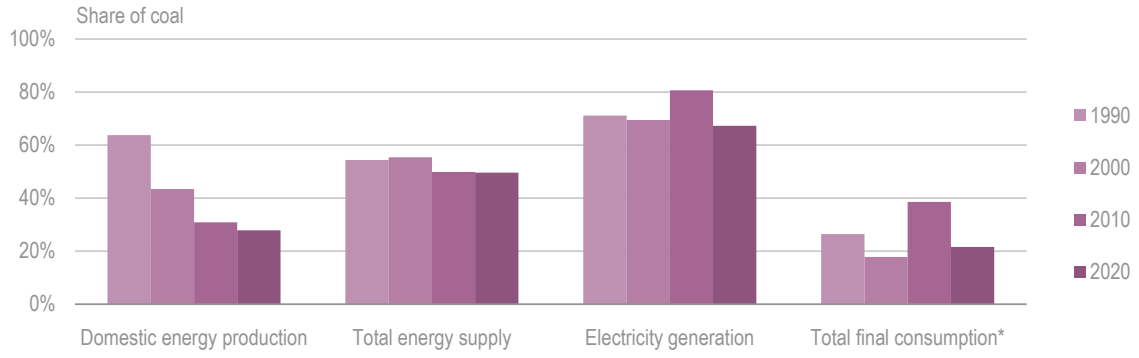
Coal remains the most important energy source in Kazakhstan, making up around 50% of the energy supply. Over 70% of electricity is produced with coal, and over 20% of final consumption is coal-based. The share of coal in residential energy consumption is among the highest in the world.

Kazakhstan possesses the world's tenth-largest coal reserves. Much is relatively inexpensive to mine as it is found in thick seams near the surface, particularly in the central and northern parts of the country. Most Kazakh coal has high ash and sulphur content, as well as high moisture content and low heating value. Kazakhstan mined 103.3 Mt of hard coal and lignite in 2020, only slightly below the level of 2019. Some 25 companies mine coal, 4 of which accounted for around three-quarters of output in 2020. There is no state coal company, and no direct subsidies.

Approximately 20% of Kazakhstan's coal is exported, mostly to Russia. Only 1% of coal exports typically go to destinations outside the FSU, mostly to China.

Kazakh coal emits relatively large amounts of particulate matter (PM) and SO_2 when combusted. Environmental impacts related to coal production include the disposal of solid waste and wastewater, and the release of coal mine methane.

Figure 4.1 Share of coal in country's energy system, 1990-2020



Coal is the main source for electricity in Kazakhstan with the average share above 70% of the total generation.

* Includes non-energy use.

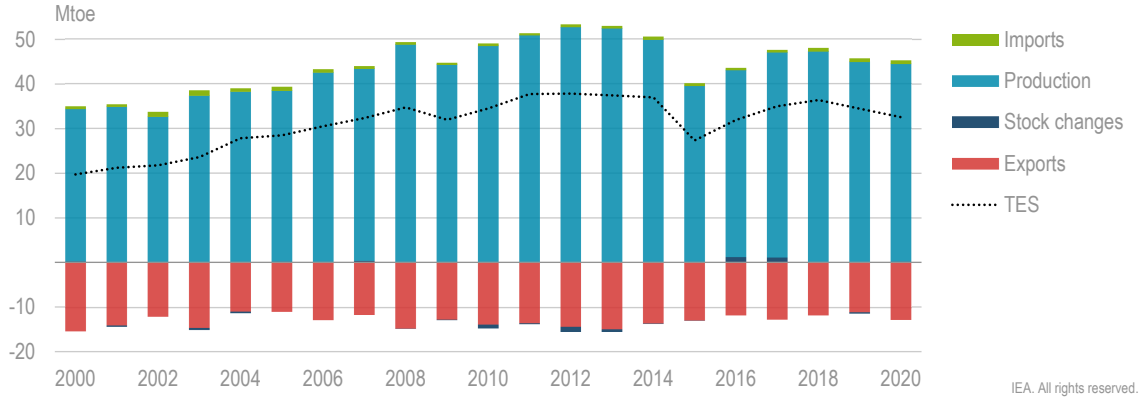
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Supply and demand

Total energy supply from coal stood at 32.6 Mtoe in 2020, a modest 6% decrease from 2010. Production decreased by 9% over the same period. According to the available data, domestic coal demand peaked in the early 2010s and is on a slightly decreasing trend.

Kazakhstan mainly produces steam/thermal coal (around 90% of production), and is among the largest coal exporters, even if exports have decreased by 8% since 2010.

Figure 4.2 Coal supply by source, 2000-2020



Kazakhstan is among the world's largest coal producers.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Reserves

Kazakhstan has the world's tenth-largest coal reserves, representing over 230 years of production at the current rate (MoE, 2021). Recoverable reserves are 33.7 Bt, or about 2.4% of the world total. A+B+C1 reserves (the Commonwealth of Independent States [CIS] rough equivalent to proven + probable) are 29.4 Bt, located in nearly 50 identified deposits (Kazenergy, 2021).

Bituminous and sub-bituminous coal accounts for about two-thirds of Kazakhstan's reserves, while the remaining third is lignite. The largest basins are found in the central and northern parts of the country, including Ekibastuz (10 Bt), Karaganda (6.9 Bt) and Turgay (5.9 Bt). The coal in the largest producing basin, Ekibastuz, is particularly inexpensive to mine as it is found in thick seams near the surface (Kazenergy, 2021).

Production

There are at least 25 companies producing coal in Kazakhstan, all private. Four companies account for around three-quarters of all output. The largest of these, Bogatyr Komir, has typically produced around 40% in recent years. (It is owned 50% by Samruk Energy and 50% by Russian company RUSAL.) The second-largest mining group, Eurasian Energy Corporation, accounts for about one-quarter of Kazakh output from its Vostochniy and Shurbarkol Moir mines. The third-largest group is ArcelorMittal Temirtau (Kazenergy, 2021). In contrast to most other energy subsectors in Kazakhstan, there is no state coal mining company (MoE, 2021).

Kazakhstan mined 109.2 Mt of coal and lignite in 2020, only slightly below the level it produced in 2019 (MoE, 2021), reflecting the fact that domestic coal demand apparently did not drop significantly due to the Covid-19 pandemic. Hard coal accounted for 103.9 Mt, of which coking coal was 10.1 Mt.

About 92% of coal mined in 2020 came from the Pavlodar and Karaganda oblasts (Kazenergy, 2021). In Pavlodar, much of the output is from three giant open-pit mines in the Ekibastuz Basin: Bogatyr, Severniy and Vostochniy. Much of the output from Ekibastuz is sent to nearby Russian power stations across the border. Most of the country's lignite production takes place in Pavlodar oblast's Maykuben Basin (Kazenergy, 2021).

In Karaganda, mining mainly takes place underground, and the main customers are the nearby metallurgy plants, although some coal is exported to iron and steel plants in Russia. (Kazenergy, 2021).

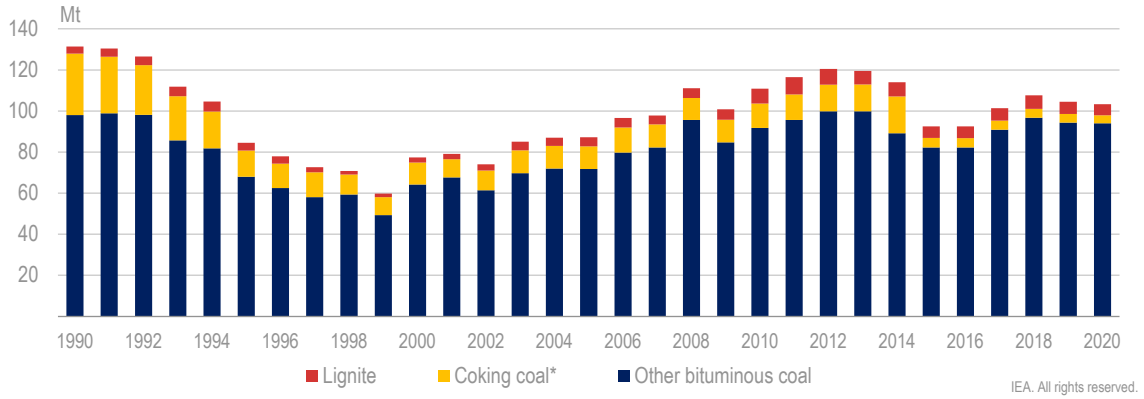
In the past ten years, a number of small open-pit mines have been developed in the Aktobe, Almaty and Turkestan oblasts to serve nearby consumers (Kazenergy, 2021).

Most work at open-pit coal mines employs rotary and hydraulic excavators, mechanical shovels, and heavy-duty dump trucks. Some mines also feature automated crushing and dispatching units (MoE, 2021).

Most Kazakh coal is relatively inexpensive to produce. Kazakhstan's coal industry is distinguished by the absence of government subsidies, in contrast to the situation in many other coal-producing countries (MoE, 2021).

Given the government's plans to reduce coal consumption in order to meet its climate goals, production is expected to gradually decline over the next three decades. The base-case scenario used in the 2021 Kazenergy report assumes an annual output decline of 1.5% through 2050 (Kazenergy, 2021).

Figure 4.3 Coal production, 1990-2020



Coal production is expected to gradually decline over the coming decades.

* Until 2014, coking coal production data correspond to raw ("run-of-mine") production.
Note: Historical coal classification is not fully compatible with the Standard International Energy Product Classification (SIEC).
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Trade

Historically, about 25% of coal production has been exported, though over the past decade the figure has been closer to 20%. Russia is the main destination, and in 2020 accounted for 86% (20 Mt) of Kazakhstan's 29 Mt of coal exports. Most of this was for Russia's Ekibastuz power station, which was designed during the Soviet era to burn coal from the Ekibastuz Basin across the border in Kazakhstan.

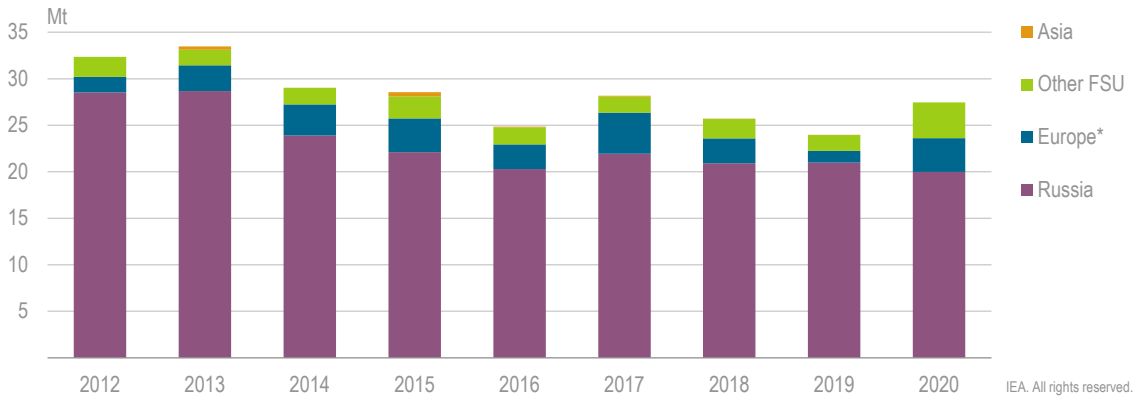
Exports to and through Russia have been facilitated to some extent by the creation of the EAEU in 2015, under which Kazakh shippers are able to benefit from the same rail rates across Russia as Russian companies (Kazenergy, 2021).

Kazakhstan exported approximately 0.9 Mt of coal to Ukraine in 2020. This consisted mostly of coking coal from ArcelorMittal's mines to the steel plants owned by that company in Ukraine. However, Kazakh exports to Ukraine have been hindered in recent years by Russian restrictions on Russia's own coal shipments to that country, which Russia apparently also has applied to transit deliveries. Kazakhstan brought a complaint about this to the EAEU, which ruled in Kazakhstan's favour in 2019. In response, Russia increased the amount of Kazakh coal it would allow to transit to Ukraine (Kazenergy, 2021). In early 2022, however, most if not all exports to Ukraine by rail via Russia were halted following the Russian invasion of that country. Kazakh exports to Asian markets have also reportedly faced challenges gaining access to relevant Russian rail and port infrastructure (Kazenergy, 2021). Kazakhstan exported approximately 0.9 Mt of coal to Kyrgyzstan in 2020.

Kazakhstan exports modest amounts of coal to the European Union, limited to higher-quality output from the Shubarkol Basin (Kazenergy, 2021). However, the IEA has observed notable differences between the official Kazakh customs trade data and data from European sources.

Only about 1% of Kazakh coal exports are to destinations outside the FSU or Europe, most going by rail to China. Some shipments of Kazakh coal sent by sea to the eastern Chinese province of Zhejiang reportedly began arriving in October 2021 after first being sent westward by rail for loading at the Russian port of Novorossiysk (Eurasianet, 2021).

Figure 4.4 Coal exports by country, 2012-2020



Most Kazakh coal exports go to Russia.

* For Europe, notable discrepancies are observed between the official customs trade data and other sources.
Notes: Export breakdown available since 2012.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Consumption

Coal accounted for 50% of Kazakhstan's primary energy consumption in 2020, or around 32.2 Mtoe (75 Mt). The largest share (69%) in energy terms, 22.1 Mtoe (53.1 Mt) was consumed in Kazakhstan's coal-fired thermal power plants and district heat system, which generated about 70% of the country's electricity that year. Most of Kazakhstan's coal-fired power plants are located in its coal-producing regions within the northern power zone.

Industrial enterprises consumed 5.3 Mtoe (16%) of coal in 2020, notably in the metallurgical industry. There is also a small but growing amount of coal processing for the creation of higher-value products (see below). Comparable data for industry are only available since 2015; therefore, the long-term demand may be misleading.

The residential sector is an important coal consumer in Kazakhstan with 12% (3.7 Mtoe) of total coal demand, primarily for heating. Coal is widely used due to its availability and relatively low price despite inefficient technologies and negative impact on indoor air quality.

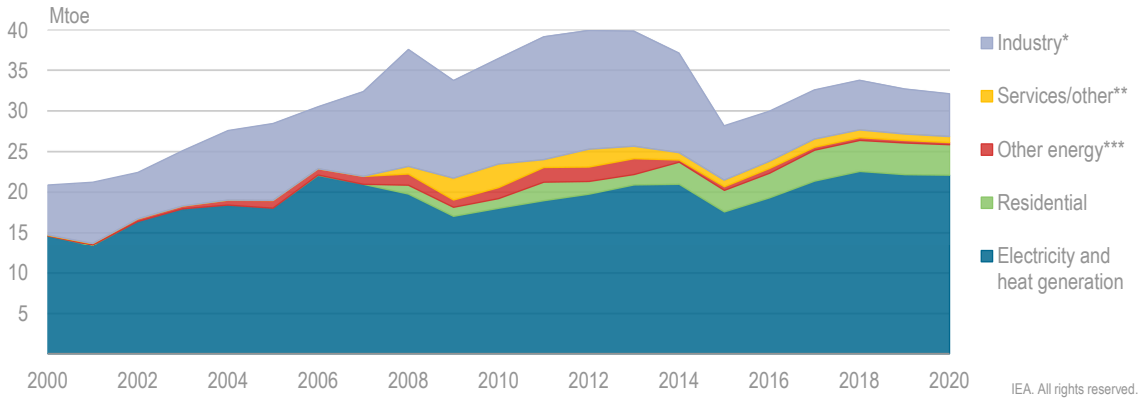
Despite a 100% electrification rate and an increasing level of access to the gas network, around 30% of Kazakhstan's households continue to burn solid fuels, primarily coal, at least on occasion. Based on a survey of 21 000 households conducted in 2018 by Kazakhstan's BNS, the national average coal consumption per household per day was

31 kilogrammes (kg) in urban areas and 33 kg in rural areas, with some variation by region, depending on local climate and level of access to gas (IEA, 2020).

The household sector's share of coal consumption reportedly has declined over the past decade, a trend that has accelerated in recent years due to increased access to the gas network.

In 2021, President Tokayev stated that, as part of Kazakhstan's plans to achieve the goals of the Paris Agreement and the country's carbon neutrality, the country was considering decommissioning all coal-fired power plants by 2050 (Kazinform, 2021). Given such climate-related considerations and those of many of its export destinations, there is likely to be a continued gradual decline in coal consumption, though coal will probably remain an important domestic energy source in Kazakhstan for at least the next two decades.

Figure 4.5 Coal demand by sector, 2000-2020



The power & heat sector is the largest coal consumer.

* Includes energy use in the industry sector and transformation losses in coke ovens and blast furnaces.
** Includes commercial and public services, agriculture, forestry, fishing and unspecified consumption.
*** Includes coal mines, unspecified consumption in the energy sector and distribution losses.

Notes: There's often discrepancy between reported coal supply and consumption statistics (=statistical difference). Between 2000 and 2020, the statistical difference averages around 5% but ranges between -7% (negative value indicating that supply exceeds demand) and 6% (positive value indicating that supply is below demand). Data for residential sector available since 2007.

Institutional and policy framework

The coal industry is overseen by the Ministry of Industry and Industrial Development, and regulation is guided by the 2017 Subsoil Code.

In 2019, the government adopted the Roadmap for the Development of the Coal Industry for 2019-2021, which was developed by the Ministry of Industry and Infrastructural Development. As of mid-2022, the roadmap was apparently still the main policy document for the coal industry. Acknowledging the gradual decline of domestic consumption in the coming years, the roadmap emphasises the further modernisation of processes at mining operations and the promotion of coal exports. It also calls for the development of industries engaged in deeper processing of coal to obtain higher-value products, such as liquid fuels, building materials, carbon black, tar, gases, solvents and activated charcoal, as well as

the utilisation of coalbed methane. Important methods it suggests for doing this include tax preferences and support for research and development.

The roadmap also calls for the introduction of a digital platform for coal sales to the population, with the aim of keeping prices low by cutting out trade intermediaries (Trend, 2020; Energy Central, 2020).

Prices

Coal prices are not regulated, though trade is monitored closely by the Ministry of National Economy and Ministry of Trade and Integration (Kazenergy, 2021).

Prices for coal used in electricity production and industry are generally negotiated directly between buyers and sellers, while prices for residential and commercial consumers are determined through sales on various commodity exchanges. Domestic prices reportedly are about one-third lower than export prices (Eurasianet, 2021).

There have been periodic discussions about direct regulation of coal prices for residential consumers, but so far, the government apparently has concluded that the price level does not merit such intervention (Kazenergy, 2021).

Transportation costs form an important component of the coal price for both the domestic and export markets. KREM regulates rail transportation tariffs within Kazakhstan. Coal reportedly accounts for around 25% of the volume of rail shipments in the country and benefits from relatively favourable tariffs compared with other goods (Kazenergy, 2021).

In December 2020, the government eliminated a 4.7% export tax on coal, in response to requests by the EAEU to remove barriers on intra-EAEU trade. The government subsequently raised the mineral resource extraction tax on all coal production from 0% to 2.7%, a move that reportedly resulted in raising an equivalent amount of revenue (Kazenergy, 2021), though presumably also led to upward pressure on domestic coal prices.

Environmental and climate issues

One of the most significant environmental impacts of the coal sector is GHG emissions and other pollutants that are produced when the coal is burned, including CO_2, carbon monoxide (CO), nitrogen oxides (NO_x), and sulphur oxides (SO_x), as well as PM and soot. Most of Kazakhstan's coal contains relatively large amounts of ash, sulphur and moisture while possessing low heating value. As such, it emits relatively large amounts of PM and SO_2 when combusted. The small amounts of coal produced from the Shubarkol Basin are lower in ash and sulphur content and have a higher heating value.[11]

Coal-fired power plants in Kazakhstan do not generally employ advanced controls for emissions of PM, SO_x and NO_x. For example, none of Kazakhstan's plants uses electrostatic precipitators or bag filters for PM. As noted elsewhere in this report, the new Environmental Code, which came into effect in July 2021, requires "Category-I"

[11] Shubarkol coal reportedly has an ash content of 5-15%, a sulphur level of 0.5%, and a heating value of 5 600 kcal/kg (Kazenergy, 2021).

enterprises, i.e. the most polluting, to implement BAT for the mitigation of certain non-CO_2 pollutants. The list of 97 Category-I enterprises includes the country's 14 largest coal-fired power plants. The programme will include a process for applying for an Integrated Environmental Permit (IEP) to certify that the plant is in compliance with BAT or has an approved plan to bring it into compliance. Having an IEP will exempt an enterprise from paying emissions fees, while a Category-I company without an IEP will be subject to increased fees. However, for energy-producing facilities, such as power plants and heat plants, the plan is to have substantially reduced coefficients for such fees compared with those for other types of facilities not possessing an IEP.

Environmental impacts related to the production of coal generally include the disposal of solid waste and wastewater, as well as the release of coal mine methane during the mining process. The government estimates that total GHG emissions from mining were 21.6 Mt CO_2-equivalent in 2019, almost all of which were methane. However, coal mining methane emissions everywhere are generally difficult to estimate, since actual emissions can vary significantly across countries and deposits, depending on the characteristic of the specific deposit (Kazenergy, 2021). There appears to be little available data on the coal industry's use and disposal of solid waste and wastewater (Kazenergy, 2021).

Efforts by coal mining companies to reduce environmental impacts reportedly have focused on addressing emissions of dust and methane, increasing operational efficiencies (so as to consume less energy), and improving the storage and treatment of solid and liquid waste. For example, in the Karaganda Basin, Bogatyr Komir is reportedly capturing methane emissions for use in on-site electricity generation. The company also has found local enterprises that can use its waste slag and ash in road construction materials, while ArcelorMittal has used slag waste in the production of cinder blocks.

Assessment

Kazakhstan's coal reserves are among the largest in the world and relatively inexpensive to mine. This has helped coal maintain its place as the country's most important energy source. Coal currently accounts for around 50% of Kazakhstan's energy supply, over 70% of its electricity generation and over 20% of final consumption. Moreover, Kazakhstan has one of the highest rates of household coal use in the world.

Unfortunately, coal has a number of important negative environmental impacts. These include emitting a significantly higher level of GHGs and other pollutants compared with alternative fuels when burned, notably including CO_2, CO, NO_x and SO_x. The relatively high level of sulphur and ash in most Kazakh coal also leads to high emissions of PM and SO_2 and contributes to indoor and outdoor air pollution, with consequences for human health.

An important problem with coal mining the world over concerns the release of coal mine methane, including from abandoned and decommissioned mines. Methane is a GHG that is significantly more potent than CO_2 as a contributor to climate change. Some Kazakh mines have begun addressing this problem, including by finding uses for the leaking methane, such as using it for electricity generation to power mining activities. However, as in many countries, more work is required to accurately quantify and control methane

emissions from Kazakhstan's coal mines. Providing companies with incentives, such as tax advantages for harnessing coalbed methane for on-site use, may encourage more mines to address this issue.

Many of Kazakhstan's coal-fired power plants are old, inefficient and polluting. The IEA welcomes the government's plans under the new Environmental Code to promote investments in BAT for the mitigation of certain non-CO_2 pollutants, which will initially affect the country's 14 largest coal-fired power plants.

The government has made a number of climate-related commitments as a signatory to the 2015 Paris Agreement. As part of these, the government has undertaken ambitious plans to decrease the share of coal in power generation. In addition to increasing the deployment of gas-fired generation and renewables, it has discussed phasing out coal-fired power plants by 2050 as part of its efforts to decarbonise the energy sector by 2060.

Kazakhstan has held several auctions to construct new, more flexible generation, such as gas-fired plants, similar to auctions it has conducted to build renewable generating capacity. Given the low cost of coal, however, it can be difficult for new plants to compete with established coal-fired ones. The capacity market may be a good opportunity to help level the playing field for less-polluting plants by introducing restrictions on participation based on emission levels and flexibility. This would take into account the hidden environmental costs of coal-fired generation and ensure that the capacity market does not end up serving as a subsidy programme for existing coal-fired plants.

Although coal prices in Kazakhstan may not reflect all of coal's external environmental costs, the country does not provide direct subsidies to the coal industry, unlike many countries that possess large coal sectors. The IEA encourages Kazakhstan to continue avoiding subsidies for the coal industry. Not only do energy subsidies in general lead to economic distortions, but coal subsidies in particular could significantly retard the penetration of renewables and gas, as well as make it more difficult eventually to deal with the economic and social challenges that typically accompany a decrease in coal mining.

The Roadmap for the Development of the Coal Industry acknowledges that domestic coal consumption is likely to decline over the coming decades, in line with the government's climate goals. It addresses the challenges through a number of initiatives. This includes the promotion of industries engaged in deeper processing of coal to produce higher-value products, including through government support for research and development in this area.

The roadmap also calls for a greater emphasis on coal exports. However, the challenges in this direction include the low quality of Kazakh coal, access to export routes, and perhaps most importantly the fact that many potential export destinations are undergoing similar policy discussions regarding the role of coal in their economies.

Recommendations

The government of Kazakhstan should:

- Intensify efforts to reduce emissions from coal-fired power plants by adopting more stringent air pollution standards for such plants, including through BAT, and ensuring enforcement. Ensure that Kazakhstan's BAT and technical emissions standards are in line with international best practice.
- In the longer term, diversify away from coal, in order to meet the government's goal to achieve carbon neutrality by 2060.
- Begin planning for the economic transformation in coal-mining regions that will eventually be affected by reduced or discontinued coal production, with a view to developing alternative sources of employment.
- Provide fiscal or other incentives to encourage mining companies to capture and use coal mine methane where technically feasible, e.g. for generating power.
- Continue support for research, development and deployment of technologies aimed at deeper processing of Kazakh coal to produce new, higher-value products.

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5. Electricity

Key data

(2020 provisional)

Total electricity generation: 110.9 TWh (coal 67.3%, natural gas 21.7%, hydro 8.7%, solar 1.3%, wind 0.9%, oil 0.1%, bioenergy <0.1%), +34.2% since 2010

Total available capacity: 20.1 GW

Electricity net exports: 0.75 TWh (imports 1.57 TWh, exports 2.32 TWh)

Electricity consumption: 80.1 TWh (industry 54.9%, residential 17.8%, energy sector 12.4%, services/other 11.2%, transport 3.7%), +27.0% since 2010

Overview

Kazakhstan's power system is dominated by coal, which accounted for nearly 60% of installed capacity and 70% of generation in 2020. The government aims to significantly reduce the share of generation from coal in order to help meet its environmental and climate goals. However, the country's abundance of inexpensive coal makes this a challenge.

Gas-fired power accounted for about 20% of generation in 2020, though most of this was in the oil- and gas-producing western power zone, which is isolated from the rest of the country. Most of the 11% of electricity generated from renewable sources in 2020 came from large hydropower plants, much of whose capacity is tightly regulated by agricultural irrigation schedules. Wind and solar represented only around 1% of generation each in 2020. Kazakhstan has held a number of successful auctions aimed at significantly increasing the future share of such renewables.

Kazakhstan lacks flexible generating capacity and in practice relies significantly on parallel operation with the Russian power system to cover imbalances and maintain frequency stability. The shortage of flexible capacity is likely to become an increasing challenge as more variable renewables are added to the system.

Increased electricity demand from illegal cryptocurrency mining reportedly has led to significant growth in consumption since 2021, including unexpected demand surges. The high level of wear and tear on the system is contributing to increasingly frequent unplanned shutdowns of generation and transmission capacities.

As in other energy subsectors, the authorities are concerned about keeping end-user tariffs low for social welfare reasons. Although the country has introduced a number of market mechanisms over the years, these appear to have had limited impact in lowering costs or stimulating investment.

Although Kazakhstan does not have any nuclear power plants, it ranks first in the world in uranium mining production and is involved in other stages of the nuclear fuel cycle. The government has been publicly discussing the idea of building a nuclear plant with Russian technological assistance and has begun to evaluate other reactor technologies from countries such as China, France, Japan, Korea and the United States.

Supply and demand

Capacity

As of the beginning of 2021, Kazakhstan had 179 power plants with a total installed capacity of 23.6 GW and an available capacity of 20.1 GW (KEGOC, 2021). Between 2014 and 2021, installed capacity increased by 2.8 GW, or about 13% (Kazenergy, 2021).

Table 5.1 Installed capacity as of 31 December 2020

		2020 capacity		2020 generation	
Power plant type	**Count**	**MW**	**Share (%)**	**GWh**	**Share (%)**
Thermal	**68**	**19 420**	***82.2***	**96 190**	***89.0***
Steam turbines	53	17 405	*73.7*	86 663	*80.2*
of which: pulverised coal	47	13 405	*56.7*	74 498	*68.9*
of which: gas and fuel oil	6	3 998	*16.9*	12 165	*11.3*
Gas turbines	15	2 015	*8.5*	9 528	*8.8*
Renewables	**122**	**4 202**	***17.8***	**11 896**	***11.0***
Hydropower plants	47	2 734	*11.6*	9 546	*8.8*
of which: small HPPs	?	212	*0.9*	?	
Wind farms	29	509	*2.2*	1 093	*1.0*
Solar power plants	45	958	*4.1*	1 252	*1.2*
Biogas plants	1	1	*0.0*	5	*0.0*
Total	**190**	**23 622**	***100.0***	**108 086**	*100.0*

Note: GWh = gigawatt-hours.
Source: Calculations by author based on data on capacity and generation from KEGOC (2021).

Kazakhstan's power sector is dominated by coal. Overall, about 57% of total installed capacity is coal-fired. Gas-fired capacity is second with around 25%, most of which is based on steam turbines that are also able to run on fuel oil. RES, including hydropower, wind, solar and biogas, account for nearly 18% of installed capacity, or 6% if hydropower is not included.

There are substantial differences among the three zones of Kazakhstan's United Energy System. Coal-fired capacity is particularly dominant in the northern zone, which is home to most of the country's coal mines and heavy industry and is by far the largest subsystem.

The more densely populated southern zone is connected to the north by three 500 kilovolt (kV) lines. It relies somewhat less on coal-fired generation and contains most of the country's hydropower and solar PV installations. However, it is a power deficit region that

imports significant amounts of (coal-fired) power from the north. Despite the increased availability of gas in the south via the new Beyneu-Shymkent pipeline, gas-fired power in the southern zone has had difficulty competing with much lower-priced coal-fired capacity from the northern zone (Kazenergy, 2021).

The sparsely populated western zone is not connected to the other two zones. Most of the major oil and gas projects are located here, so it is not surprising that the western zone has by far the largest share of gas-fired capacity, although it also has a significant number of coal-fired plants.

Table 5.2 Available capacity by zone (MW) as of 31 December 2020

	Northern	Share (%)	Southern	Share (%)	Western	Share (%)	Total	Share (%)
"Fossil"*	12 148	*86.3*	2 082	*63.7*	1 449	*53.1*	**15 679**	*78.1*
Gas turbine	503	*3.6*	46	*1.4*	1 228	*45.0*	**1 777**	*8.9*
Hydro	1 045	*7.4*	589	*18.0*	-	*0.0*	**1 633**	*8.1*
Wind	165	*1.2*	95	*2.9*	49	*1.8*	**309**	*1.5*
Solar	219	*1.6*	459	*14.0*	2	*0.1*	**680**	*3.4*
Biogas	1	*0.0*	-	*0.0*	-	*0.0*	**1**	*0.0*
Total	**14 080**	*100.0*	**3 271**	*100.0*	**2 728**	*100.0*	**20 079**	*100.0*

* Includes steam turbines mostly running on pulverised coal, but also some running on gas or fuel oil.

Source: data from KEGOC (2021).

The period 2009-2015 saw major investments in existing and new generating capacity. Plants were able to apply for temporarily higher tariffs for this period as long as they committed to investment plans under the "tariff-for-investment" programme. This stimulated some USD 6.8 billion in modernisation and expansion and led to an additional 3 000 MW of capacity (Kazenergy, 2021). However, major investments to upgrade and add capacity have been limited since then, while Kazakhstan's generating assets continue to feature a high level of wear and tear. The average level of depreciation of generation assets is 53%, and most of the main generating plants have been in operation for over 40 years. There has been an increase in both scheduled and emergency repairs in recent years (Kazinform, 2022a). The new Environmental Code is attempting to address some of the sector's further investment needs, as well as the government's environmental agenda, by imposing requirements to transition to the principles of BAT (see Environmental section).

Kazakhstan recognises that there is a shortage of flexible capacity in its system, and that this will only increase as more intermittent renewables, such as wind and solar, are added. All coal-fired generation is baseload, while about half of hydropower capacity is tightly regulated by water irrigation schedules, leading to significant availability problems for its use in regulating load. Imbalances are further exacerbated by increasingly frequent unplanned shutdowns of generation and transmission capacities. In practice, Kazakhstan relies significantly on parallel operation with the Russian power system to cover imbalances and to maintain frequency stability under a 2009 agreement between Kazakhstan's grid operator, KEGOC, and Russia's Inter RAO (KEGOC, 2021).

The government notes that 17.5 GW of new generating capacity will be required by 2035 to cover an expected average annual 2.7% increase in demand between 2021 and 2035 (Kazinform, 2022b). This is expected to include both RES and flexible gas-fired capacity, though may also include one or more nuclear power plants.

Generation

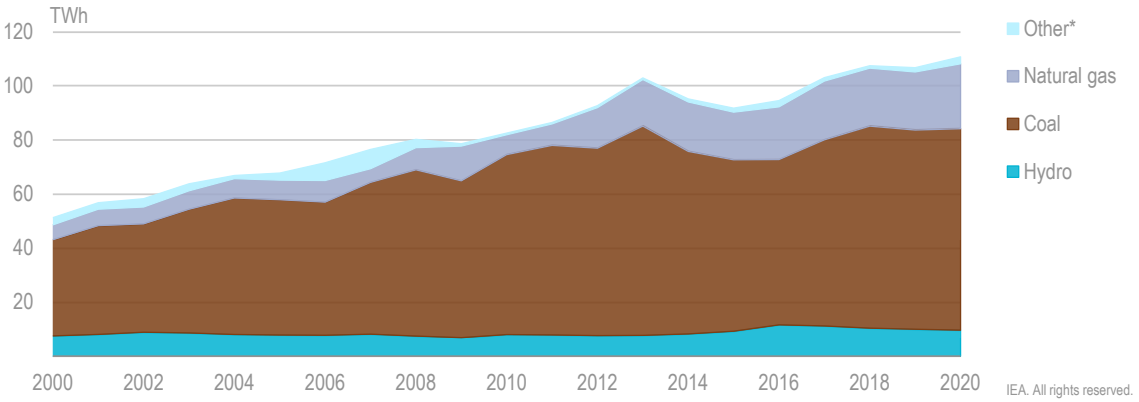
Kazakhstan generated 111 GWh in 2020.[12] This was an increase of around 34% from 2010. As in most other recent years, nearly 70% of generation in 2020 was generated from coal-fired plants, down from about 80% in 1990. Some 20% of electricity in 2020 was gas-fired, and 11% came from RES.

Most of the electricity generated from renewable sources came from HPPs, though only around 1% of this came from small hydropower. Around 1% each came from wind and solar. As of December 2021, electricity production from the country's 134 renewable energy facilities represented 3.3% of generated power in 2021, not including large HPPs (Kazinform, 2021a).

The Development Strategy to 2050 and the Green Economy Concept aim to significantly reduce the share of generation from the combustion of coal. According to the Energy Balance until 2035, which was approved by the Ministry of Energy in March 2022, coal is expected to account for around 40% of electricity generation by 2035, gas 38%, renewables (not including hydropower) 15%, and hydropower 7% (MoE, 2022).

The Energy Balance until 2035 estimates that it will be necessary to commission 17.5 GW of new generating capacity by 2035, including to replace that which is likely to be decommissioned by then. The current assumption within the Ministry of Energy is that the additional capacity will consist of about 6.5 GW fuelled by renewables, over 5 GW of gas-fired capacity, over 2 GW of hydroelectric capacity, and 2.4 GW of nuclear capacity.

Figure 5.1 Electricity generation by source, 2000-2020



Electricity generation has more than doubled since 2000 but remains dominated by coal.

* Includes solar PV, wind, oil and bioenergy.

Note: TWh = terawatt-hours.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Electricity production is dominated by five groups, which in 2019 together accounted for 68% of generation. JSC Samruk-Energo's 11 power stations produced 31% of total generated power; Eurasian Resources Group's (ERG's) 6 power stations generated 17%; JSC Central-Asian Electric Power Corporation (CAEPCO) group's 4 stations produced

[12] Small differences between generation data from KEGOC and the BNS can be attributed to statistical accounting.

7%; and Kazakhmys Group's 3 power stations 7%. All other power stations together accounted for the remaining 32% of electricity generated that year (KOREM, 2020).

Cross-border connections

The northern zone is connected to and synchronised with Russia's Siberian and Urals integrated electricity systems (IES) via nine 500 kV lines, ten 220 kV lines, and numerous 110 kV lines.

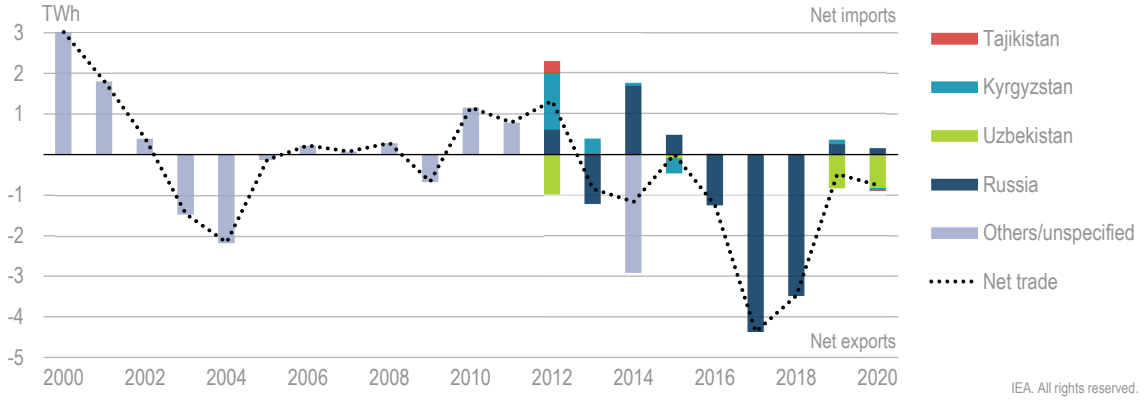
The southern zone, which is connected to the northern zone, is interconnected to and synchronised with the Uzbek and Kyrgyz energy systems as part of the Central Asia Power System (CAPS). There are five interconnections with Uzbekistan; one 500 kV line, two 220 kV lines and two 110 kV lines. Kazakhstan also has ten interconnections with Kyrgyzstan: two 500 kV lines, four 220 kV lines and four 110 kV lines.

The western zone, which is isolated from the country's other two zones, is connected to Russia's Urals and Middle Volga IES via three 220 kV lines.

Imports and exports

Most electricity trade in recent years has been related to power exchanges with Russia in order to maintain frequency stability and cover supply imbalances.

Figure 5.2 Electricity trade by country, 2000-2020

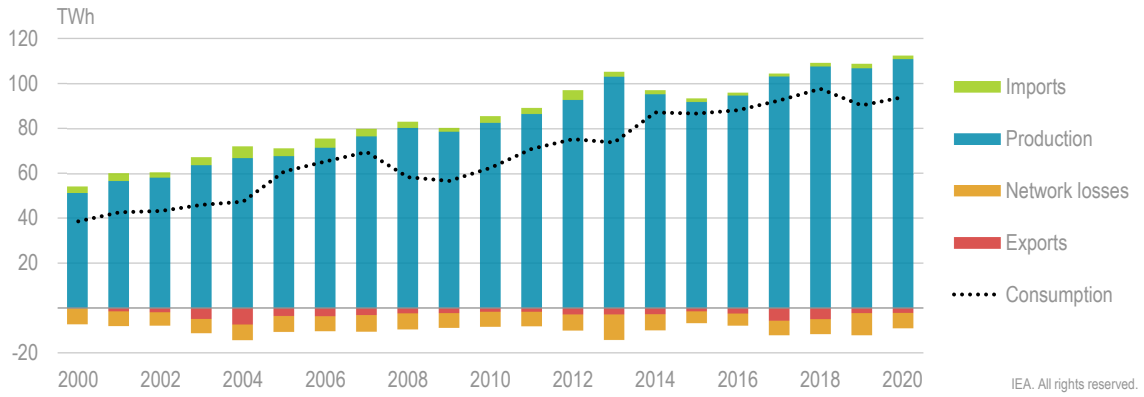


Most power trade is with Russia, even if small on a net basis.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

According to KEGOC, imports from Russia in 2020 were 1 241 GWh, while Kazakhstan's exports to that country were 1 118 GWh. In 2021, imports from Russia were 1 788 GWh, while exports to Russia were 1 327 GWh. Kazakhstan pays considerably more on average for the power it imports from Russia than the latter pays for the power it receives from Kazakhstan, since power imported by Kazakhstan usually is at peak times or required at short notice. During the winter of 2021/22, Russia reportedly was set to significantly increase the normal level of exports to Kazakhstan, due to a risk of shortage in the Kazakh system (Korem, 2021a).

Figure 5.3 Electricity supply by source, 2000-2020



Kazakhstan is largely self-sufficient in electricity on a net basis.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Kazakhstan also has connections with Uzbekistan and Kyrgyzstan. Exports to Central Asia in 2020 were 1 179 GWh, of which 811 GWh went to Uzbekistan, 356 GWh to Kyrgyzstan, and 12 GWh to Tajikistan. Imports from Central Asia that year were 315 GWh, of which 303 GWh came from Kyrgyzstan and 12 GWh from Tajikistan. Exports to Central Asia in 2021 were 1 325 GWh, of which 638 GWh went to Uzbekistan and 687 GWh to Kyrgyzstan. Imports from Central Asia during the same year were 305 GWh, all of which came from Kyrgyzstan.

EAEU

As a member of the EAEU, Kazakhstan is involved in establishing the Common Electricity Market, which the EAEU plans to launch in 2025. According to the Action Plan approved by the Supreme Eurasian Economic Council in December 2019, members are currently preparing a number of key documents, including access rules for cross-border transmission capacity, trading rules and rules for cross-border network development. The other EAEU members that will form the EAEU Common Electricity Market are Armenia, Belarus, Russia and Kyrgyzstan.

Consumption

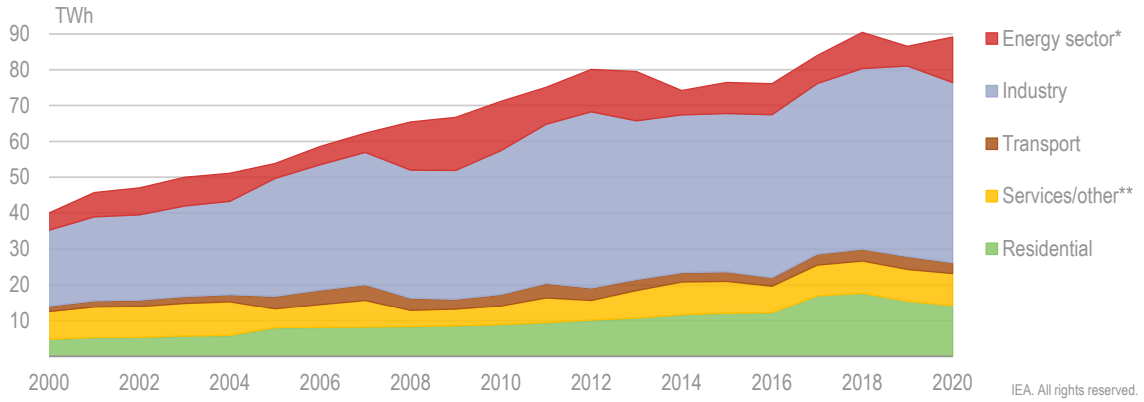
Electricity consumption decreased significantly after Kazakhstan's independence in 1992 and only reached 1990 levels again in 2018 (Kazenergy, 2021). In 2020, 110 GWh were supplied to the domestic grid. This was an increase of 2% over 2019 (KEGOC, 2021), a growth rate typical of the past few years that suggests Covid-19 did not have a major dampening effect on electricity demand. Consumption growth occurred in 2021 in all three zones, though particularly in the south.

Industry is by far the largest power-consuming sector and represents around half of Kazakh electricity demand (46% in 2020). The 18 largest industrial enterprises together account for about one-third of the country's total consumption (KOREM, 2020). Growth in power demand in Kazakhstan traditionally has depended on growth in industrial output, which in turn has been closely linked to world commodity markets, particularly for oil, ores and metal alloys.

The residential and service sectors accounted for 20% of consumption in 2020. Electricity consumption by households is significantly lower than in Europe, mainly due to greater use of centralised heating in Kazakhstan, combined with a lower penetration rate of electrical devices (Kazenergy, 2021).

The energy sector, including oil and gas extraction and own needs of generators, accounted for about 18% of power consumption in 2020, transport for 3% and agriculture 1%. Overall reported network losses vary depending on the source, but are plausibly between 10% and 15% of the electricity supply (Kazenergy, 2021).

Figure 5.4 Electricity consumption by sector, 2000-2020



Industry is by far the largest electricity consumer.

* Includes energy sector own use.
** Includes commercial and public services, agriculture and forestry, and unspecified consumption.

Note: Using expert estimates, large statistical differences were reallocated to iron and steel industry and power plant own use for 2005-2020.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

The Ministry of Energy expects electricity consumption to grow by an average annual rate of 2.7% from 2021, to reach 153 million kilowatt-hours (kWh) in 2035 (Kazinform, 2022b). However, electricity demand in the first ten months of 2021 suggested an increase of 8% over 2020. This is reportedly due to an explosion in illegal cryptocurrency mining in the country, possibly in response to a clampdown on such activities in neighbouring China. This in turn has led to increased power imports from Russia (Eurasianet. 2021).

Power demand falls at night, increases at the beginning of the working day and peaks in the evening (KEGOC, 2021). The yearly peak occurs during winter. Peak demand in November 2019 was 15 GW, or about 77% of available capacity (GoK, 2020). This situation reportedly grew tighter in 2021 (Kazinform, 2022b).

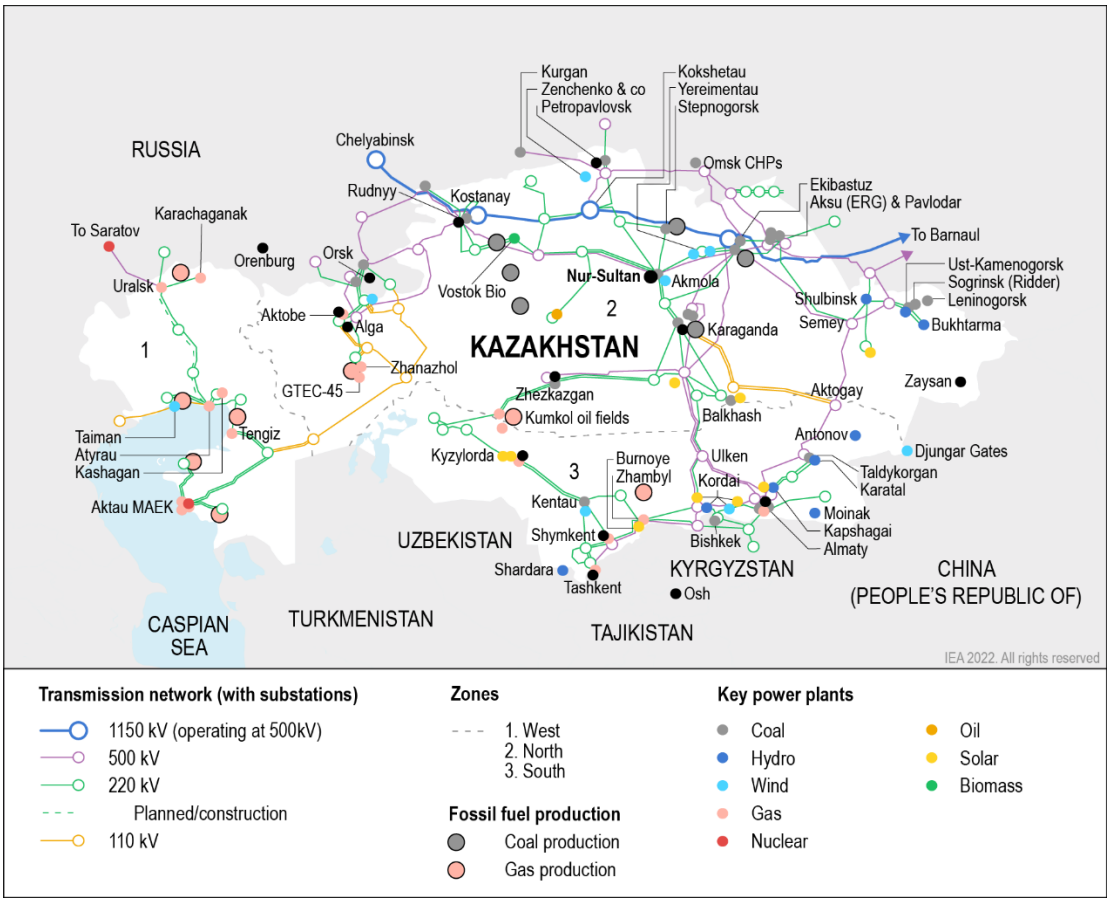
Networks

Transmission and distribution

Kazakhstan's main high-voltage networks are operated by KEGOC. Samruk-Kazyna owns 90% plus one share of KEGOC, while the remaining shares are owned by minority shareholders.

KEGOC's networks consist of over 26 000 km of overhead transmission lines, including 14 899 km of 220 kV lines, 1 863 km of 330 kV lines, 8 288 km of 500 kV lines, and 1 421 km of 1 150 kV lines. Its system contains 81 electrical substations of between 35 kV and 1 140 kV, with an installed transformer capacity of 38 746 megavolt-amperes (MVA) (KEGOC, 2021). The volume of electricity transmitted through KEGOC's networks in 2020 was 46.1 GWh (KEGOC, 2021).

Figure 5.5 Main power infrastructure



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: SEEPX Energy Limited (2021).

As noted above, the high-voltage system is divided into three zones. The northern and southern zones are connected by three long-distance 500 kV lines with a total combined transfer capacity of 900 MVA. KEGOC is studying plans to connect the western zone to the others. The least expensive option reportedly would be to connect the western and northern zones, though there is some concern that this would expand the role of coal-fired generation by backing out the western zone's relatively more expensive gas-fired capacity. The other main option would be a longer line connecting the western and southern zones, possibly running parallel to the Beyneu-Shymkent gas pipeline. This option reportedly would involve building more gas-fired capacity in the western zone (Kazenergy, 2021). The results of a pre-feasibility study looking at various options was approved by the Scientific Council of KEGOC in March 2022.

While most of the transmission system is owned and operated by KEGOC, there are nearly 200 other entities involved in transmitting electricity, such as oil and gas companies, power stations, mining companies and metallurgical plants that own or rent lines in their areas of operations. In addition to assisting the long-distance transmission of power, such operations are also sometimes involved in distributing power to nearby settlements.

The three power zones are divided into 19 regional power distribution companies of different types of ownership (state-owned, communal, private), which collectively have over 250 000 km of overhead lines between 10/6 kV and 220 kV (World Bank, 2021).

The transmission system is characterised by a high level of wear, with the depreciation rate reportedly 66% on average for regional networks (Kazinform, 2022a). Losses on the high-voltage networks operated by KEGOC were about 5.7% in 2020 and 5.6% in 2021. According to Kazenergy (2021), losses on the networks of the distribution companies in 2020 were around 10.9%. Other sources put total transmission losses as high as 18% (Kazinform, 2022a). Transmission losses are exacerbated by the long distances in the Kazakh system.

There have been increasing problems with system stability. In 2020, there were 248 emergency outages in KEGOG's networks, 17% higher than in 2019. In 2020, KEGOC recorded 48 operational disturbances, including 1 major failure, 2 Class-I failures, and 45 Class-II failures (KEGOC, 2021). The System Average Interruption Index (SAIDI) on KEGOC's networks was 0.16 hours in 2020, 0.01 in 2019, and 0.18 in 2018. The System Average Interruption Frequency Index (SAIFI) was 0.07 hours in 2020, 0.03 in 2019 and 0.03 in 2019 (KEGOC, 2021).

One of the most serious blackouts in the past several years occurred on 25 January 2022. According to KEGOC, the initial cause was a short circuit that led to the loss of six units (1 500 MW total) at the Syrdarinskaya power plant, and resulted in a power surge on the 500 kV lines connecting Kazakhstan's northern and southern zones. The disconnection of the southern zone subsequently led to disconnections with the Kyrgyz and Uzbek systems, which contributed to blackouts and significant power rationing in those countries (World Bank, 2022).

Electricity sector structure

The **Ministry of Energy** is responsible for overall policy setting and supervision of the power sector. Among other responsibilities, it sets price caps for electricity, capacity and balancing services.

KEGOC manages the main transmission grid and is also the system operator.

KREM of the Ministry of National Economy approves tariffs for KEGOC's regulated services related to transmission, dispatching and balancing. KREM approves such tariffs for a five-year period, with the most recent application submitted in July 2020 for the period 2021-2025 (KEGOC, 2021). KREM also approves the retail tariffs of the local distribution companies, as well as tariffs for heat production and transportation.

Power production is carried out by around 190 plants of different types of ownership.

Electricity is bought and sold by wholesale market participants using bilateral contracts or via the centralised wholesale electricity market.

The Kazakhstan Electricity and Power Market Operator (KOREM) conducts online auctions for day-ahead and during-the-day spot purchases. Participants in the centralised wholesale electricity market include generating organisations supplying at least 1 MW to the wholesale market, supply organisations that buy a daily average of at least 1 MW on the wholesale market and consumers that buy on average at least 1 MW of capacity, as well as KEGOC, KOREM and the Financial Settlement Centre for Renewable Energy Support LLP (FSC). As of 2021, registered participants on the centralised wholesale market included 114 power plants, 19 regional energy suppliers and 225 large consumers (Kazenergy, 2021).

In practice, most electricity is sold using bilateral contracts, while the share traded on the centralised market has been low and declining. In 2019, centralised trading accounted for 28% of supply, while in 2021 it had fallen to around 1% (Kazinform, 2021b).

The government has tasked KOREM with developing a balancing market. This was originally due to be launched in 2008, but was still in simulation mode as of the beginning of 2022. A new launch date has been set for some time in 2022. In the meantime, there appears to be little incentive for producers to sell more electricity during peak hours.

There is also a capacity market, though this reportedly has not resulted in lower prices nor investment in more flexible or less-polluting capacity.

The 2021 Kazenergy report comments that, in general, “The market instruments introduced in the electricity market to reduce prices do not give any tangible effect, and the remaining administrative and regulatory mechanisms to contain the growth of prices for electricity and heat are not flexible and transparent enough, which leads to imbalances and underfunding of the industry” (Kazenergy, 2021).

Auctions for RES and flexible capacity

RES are supposed to account for 6% of generation by 2025 and 15% by 2030. The target for 2050 is to generate 50% of the country’s electricity from “alternative” sources, which include RES but also could include nuclear power.

KOREM conducts auctions for renewable energy capacity on behalf of the FSC. The FSC is a subsidiary of KEGOC that has a mandate to serve as the centralised buyer of RES at guaranteed prices. RES built prior to 2018 benefit from higher FiTs.

Tariffs paid by the FSC to RES generators are financed by conventional power producers on a pro rata basis, according to the amount of conventional power each produces.

In 2021, KOREM scheduled five auctions, with the aim of selling the rights to build 200 MW of renewable generating capacity, of which 120 MW was reserved for hydropower, 50 MW for wind, 20 MW for solar PV and 10 MW for bioenergy. Each auction was held for particular types of capacity in particular zones. The 2021 auctions resulted in eight projects for a total of 87 MW, more than half (50 MW) of which ended up being for wind. (See renewable energy chapter for more details.) Bidding in such auctions is based on the tariff required, and the starting bid for each generation type is the highest tariff bid the previous year.

According to KEGOC's calculations, RES are currently causing nearly 20% of the supply-demand imbalance in the northern and southern zones, and around 40% of the imbalance in the western zone, leading to increasing short-term imports of power, mainly from Russia.

In order to increase the amount of flexible generating capacity available, particularly as the share of RES increases, KOREM has also begun conducing auctions for flexible capacity similar to those it has been holding for RES. In December 2021, KOREM conducted three auctions (Informburo, 2021):

- in the Kyzylorda region (southern zone), for the construction of a combined-cycle gas turbine (CCGT) with an installed capacity of 150 MW to 250 MW
- in the Turkestan region (southern zone), for the construction of a CCGT with an installed capacity of 250 MW to 350 MW
- in the southern or northern zone, for the construction of gas-fired or hydroelectric capacity of 450 MW to 550 MW.

These auctions reportedly resulted in two projects for a total of 550 MW (KOREM, 2021b).

Additional auctions for flexible generating capacity were announced for July 2022 and will consist of a combined-cycle gas-fired cogeneration[13] plant of 240 MW in the Kyzylorda region, and a 900 MW to 1 000 MW CCGT plant in the Turkestan region (KOREM, 2022).

Heat

Kazakhstan has extensive district heating networks that cover most of its urban areas. However, losses are reportedly as high as 30% (official statistics say 17%), and much of the 12 000 km network is in need of repair (Kazenergy, 2021). The average efficiency of district heating systems in Kazakhstan is reportedly 58% (MoE, 2021).

Based on a survey of 14 cities, heating systems on average depend on coal-fired co-generation plants for about 40% of their heat energy needs, gas-fired co-generation for about 20%, coal-fired boilers for about 10% and gas-fired boilers for about 30%. Co-generation plants in large cities are to be converted from coal to gas. In Nur-Sultan, for example, the conversion of all hot-water boilers at the city's two main co-generation plants is expected to be completed in 2022 (Kazinform, 2021c).

Heating networks and boiler houses are typically owned and controlled by local executive bodies. Tariffs for heat are regulated by KREM and, similar to the case for electricity, kept low for social reasons. According to Kazenergy (2021), heat tariffs are below the cost of production.

There is no separate law for heat, which is covered by the Law on Electricity, though the Ministry of Energy reportedly is drafting a new law on heat regulation (Kazenergy, 2021).

[13] Co-generation refers to the combined production of heat and power.

Nuclear energy

Kazakhstan mines and exports uranium and has one of the world's largest uranium reserves.[14] It also processes and exports nuclear fuel and related products. Although Kazakhstan does not have commercial power generation capacity, it has extensive experience operating research reactors and currently carries out research in a number of areas related to nuclear energy, including in co-operation with several international partners.

The main institutions involved in Kazakhstan's nuclear industry include the national mining and manufacturing company, Kazatomprom, the National Nuclear Centre, the Institute of Nuclear Physics, and the Scientific and Technical Centre for the Safety of Nuclear Technologies, all of which are subordinate to the Ministry of Energy. The Ministry of Energy's Department of Atomic Energy and Industry is responsible for promoting nuclear energy. The Ministry of Energy has formed the Interdepartmental Commission on the Nuclear Industry to bring together various stakeholders across government, academia and the mining industry to advise on state policy in the field of nuclear energy, safety and research.

The main legislation in Kazakhstan related to the nuclear industry is the Law on the Use of Atomic Energy of 12 January 2016. Additional relevant laws include the Law on Radiation Safety of the Population of 23 April 1998, the Law on Permits and Notification of 16 May 2014, and the Environmental Code (No. 400-VI) of 2 January 2021.

The Committee of Atomic and Energy Supervision and Control of the Ministry of Energy is the main regulator for the nuclear industry. Other bodies involved in regulating aspects of the nuclear industry include the Committee for Environmental Regulation and Control of the Ministry of Ecology, Geology and Natural Resources (environmental regulation), the Committee of Sanitary and Epidemiological Control of the Ministry of Healthcare (population health), the Ministry of Internal Affairs (facilities security), the Industrial Development Committee of the Ministry of Industry and Infrastructure Development (industrial safety), and the Ministry of Emergency Situations.

Kazakhstan has the second-largest identified recoverable resources of uranium in the world (in the category <USD 130 per kilogramme of uranium): about 906 800 tonnes of uranium, representing about 15% of the world total (NEA/IAEA, 2020). State-owned Kazatomprom has a number of mining joint ventures with foreign firms, including from Canada, China France, Japan and Russia. Since 2009, Kazakhstan has been the world's largest uranium producer. Uranium output was 19 500 tonnes in 2020, down somewhat from the level of 2019, due to the global Covid-19 pandemic in 2020 and in response to a sustained depressed uranium market during the past few years. Most of Kazakhstan's mined uranium is exported.

Kazakh entities are also involved in other stages of the nuclear fuel cycle. In particular, the Ulba Metallurgical Plant produces uranium dioxide powders, which are exported to a number of clients, including in Europe, Japan, Russia and the United States. It is also a certified manufacturer of fuel pellets for several international reactor types, including Russian-designed VVER and RBMK reactors and a reactor designed by France's Framatome and China's Jianzhong Nuclear Fuel (CJNF). In 2014, Kazatomprom signed

[14] This section is based primarily on information in IAEA (2021).

an agreement with China General Nuclear Corp. (CGN) focused on establishing the Ulba-FA joint venture to build a fuel fabrication plant for the production of 200 tonnes/year of fuel assemblies at Ulba. The plant was completed in 2020.

Between 1973 and 1999, Kazakhstan operated the BN-350 research reactor, the world's first experimental fast neutron reactor with a sodium coolant, and a prototype for the BN-600 reactor at Beloyarsk in Russia. The BN-350, located near Aktau, has a 1 000-megawatt thermal (MW_t) design capacity but never operated at more than 750 MW_t (potentially 350 megawatts electrical). After 1993 it operated at only about 520 MW_t when funds were available to buy fuel. The plant successfully produced electricity and 80 000 cubic metres per day of potable water over some 27 years. About 60% of its power was used for heat and desalination, and it established the feasibility and reliability of such co-generation plants. Taking into account the recommendations of an International Atomic Energy Agency (IAEA) Operational and Safety Review Team mission, the government decided in 1999 to shut down and decommission the BN-350 research reactor. This has involved placing it in safe-storage status for 50 years prior to dismantling. The BN-350 is being decommissioned by MAEC-Kazatomprom, a subsidiary of Kazatomprom. The plant housing the reactor currently employs around 170 people in several shifts whose job it is to ensure that the reactor is maintained in a safe state. The BN-350's fuel has been unloaded and placed in the Baikal-1 long-term storage facility for spent fuel.

Four additional research reactors remain in operation. Three are located on the territory of the former Semipalatinsk nuclear testing site, and another at the Institute of Nuclear Physics (INP) near Almaty. The INP's WWR-K research reactor has been used in studies related to materials science, power plant safety and the development of fourth-generation nuclear reactors. INP has been working with a number of international partners, including the Atomic Energy Agency of Japan.

The National Nuclear Centre (NNC) conducts research on the safety of nuclear energy and materials science. Based on work that began in 1998, Kazakhstan successfully constructed and commissioned a tokamak, a specialised containment vessel which uses a powerful magnetic field to confine hot plasma, and is now using it to conduct research on materials that could be used in constructing nuclear-fusion reactors. There is an agreement on the joint use of the tokamak by CIS countries. The NNC is also co-operating with partners from France, Japan and Russia on research related to the safety of fourth-generation nuclear reactors.

Five universities in Kazakhstan offer specialities in nuclear physics or nuclear power engineering. In addition, several institutes provide professional training for the nuclear industry, including the NNC, the INP, the Alatau Training Centre, the Nuclear University and the Institute of High Technologies.

Kazakhstan has been studying the possibility of building a commercial nuclear power plant for several years, with the aim of increasing generating capacity and diversifying away from dependence on coal. According to work carried out in 2014, eastern Kazakhstan and the Almaty region have been identified as the most prospective locations for any future nuclear plant, based on consideration of such factors as local infrastructure availability and potential environmental and human impacts. The Department of Atomic Energy and Industry of the Ministry of Energy noted to the IAEA in 2021 that the following technologies were currently being studied for possible use in Kazakhstan: Rosatom (Russia) VVER-1200 reactor; Electricité de France/Mitsubishi Heavy Industries Ltd (France/Japan)

ATMEA 1 reactor; NuScale Power (United States) small modular reactor; GE Hitachi Nuclear Energy (United States, Japan) BWRX-300 small modular reactor; China National Nuclear Corporation HPR-1000 reactor; and Korea Hydro and Nuclear Power APR-1400 reactor.[15]

The government began publicly discussing the idea of building a nuclear power plant with Russian technological assistance during a visit by Russian President Vladimir Putin in 2019. Public reaction reportedly was negative at the time. However, a massive growth in electricity demand in 2021 led President Tokayev to declare that the country "no longer has a choice" and "will have to make an unpopular decision" about building a nuclear power plant soon (Eurasianet, 2021).

Kazakhstan became a Member State of the IAEA in 1994, and is a member of the Commission of the CIS Member States on the Peaceful Uses of Atomic Energy. It also has bilateral co-operation agreements related to nuclear energy with Belarus, Canada, China, India, Japan, Russia, Saudi Arabia, South Korea and the United States, as well as with the European Atomic Energy Community, the European Organisation for Nuclear Research (CERN) and the United Nations Development Programme (UNDP).

Kazakhstan is a signatory to a number of multilateral agreements related to nuclear issues, including the Nuclear Non-Proliferation Treaty; the Convention on the Physical Protection of Nuclear Material; the Convention on Early Notification of a Nuclear Accident; the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; the Convention on Nuclear Safety; the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management; the Vienna Convention on Civil Liability for Nuclear Damage; the Nuclear Export Guidelines; and the Nuclear Terrorism Convention.

Environmental issues

One of the main environmental issues in the power sector is emissions from coal-fired power plants, including not only CO_2 but NO_x, SO_x and particulates. Most coal plants do not have advanced emissions control systems.

In December 2020, President Tokayev announced Kazakhstan's intention to reach carbon neutrality by 2060 (Astana Times, 2020). The government is now developing its 2060 Long-term Low-Carbon Development Strategy, key milestones of which include doubling RES in electricity generation by 2030 and total electrification of personal passenger transport by 2045. The government is also discussing the possible complete phase-out or significant reduction of coal-fired generation by 2050 (UNDP, 2021). However, according to the Energy Balance until 2035, which was released by the government in March 2022, there are also plans for 1.5 GW of new coal-fired capacity (MoE, 2022).

One of the mechanisms Kazakhstan intends to use to achieve its carbon-reduction pledges is its ETS. The ETS was initially launched in 2013, but trade was suspended in 2015 due to low liquidity. The ETS was relaunched in 2018 for the three-year period 2018-2020 with 130 participating entities that collectively accounted for over 40% of the country's CO_2 emissions, including firms in the oil and gas, mining, and power sectors, as well as

[15] See also Kazinform (2022c).

important manufacturing sectors such as metallurgy and chemicals (MoE, 2021). However, few trades reportedly have taken place on the relaunched ETS.

The new Environmental Code, signed by the president in January 2021, requires Category-I enterprises, i.e. the most polluting, to implement BAT for the mitigation of certain non-CO_2 pollutants. The list of 97 Category-I enterprises includes the country's 14 largest coal-fired power plants. The programme will include a process for applying for an IEP to certify that the plant is in compliance with BAT or has an approved plan to bring it into compliance. Having an IEP will exempt a plant from paying emissions fees, while a Category-I company without an IEP will be subject to increased fees. IEPs are expected to be introduced in 2024, and Category-I companies will have until 2035 to implement their related BAT plans. The programme is reportedly modelled on the European Union's BAT programme, though details are still being developed. Technological audits of the 97 Category-I enterprises were being carried out during 2021 to gather data to inform the further development of the programme (Kazenergy, 2021).

Assessment

Kazakhstan's electricity system is highly dependent on abundant, inexpensive coal. This makes it challenging to diversify its generation mix and fulfil its ambitious climate goals, such as the tripling of RES in electricity output by 2030 and the possible phase-out of all coal-fired capacity by 2050.

Kazakhstan is to be congratulated for essentially meeting its 2020 target of producing 3% of power from RES by 2020. The RES auctions appear to be successful in stimulating the construction of new plants, as well as bringing down the required tariffs for such capacity.

Grid stability is becoming an increasing issue in Kazakhstan, and is likely to become more important as the role of RES increases in line with Kazakhstan's targets. In order to maintain grid stability, there should be a sufficient amount of balancing or storage capacity to compliment RES. KEGOC estimates that the system currently lacks about 1 500 MW to 2 000 MW of flexible capacity for balancing (World Bank, 2021). The IEA welcomes Kazakhstan's auctions to attract investment for building more flexible, gas-fired generating capacity, similar to its auctions for RES.

Kazakhstan is to be congratulated for attempting to introduce market mechanisms in the power sector over the years. Unfortunately, a number of these have yet to achieve their aims. The capacity market has been in operation for several years but does not appear to have been effective in bringing down the price of capacity. Moreover, there are no restrictions on the type of generators that may participate in this market, such as the restrictions in the European Union that limit participation based on flexibility and emissions levels. As a result, Kazakhstan's capacity market effectively may be serving as a subsidy programme for existing coal-fired generation and missing an opportunity to stimulate the development of less polluting, more flexible capacity (Kazenergy, 2021).

The share of power traded on the centralised wholesale power market is small and has shrunk significantly in the past few years, with a corresponding rise in less transparent bilateral contracts. The main problem appears to be price caps that are set too low to stimulate interest. The Ministry of Energy sets a maximum price for electricity traded on the centralised wholesale market, but KOREM notes that the ministry's tariff policy

excludes profits when calculating this maximum (KOREM, 2020). Another reason for the low volume of centralised trading may be the high level of concentration among sellers, e.g. approximately 60% of electricity is supplied by just five generating companies (Kazenergy, 2021). The centralised exchange also lacks a settlement system and obligation to sign power supply agreements to ensure timely delivery of power and payment (Kazenergy, 2021).

Recommendations

The government of Kazakhstan should:

- Ensure any power price caps are high enough to stimulate investments in new capacity and efficiency.
- Continue and expand auctions to build RES and flexible capacity.
- In order to help meet environmental and other goals, include parameters such as GHG emissions and flexibility in determining eligibility to participate in the capacity market.
- Continue to investigate the deployment of new nuclear capacity, including small modular reactors.

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6. Renewable energy

Key data

(2020 provisional)

Total renewable energy supply: 1.1 Mtoe (1.7% of TES) (75% hydro, 12% solar, 8% wind, 5% bioenergy)

Total renewable electricity supply: 12.2 TWh (11.0% of electricity generation) (9.7 TWh hydro, 1.5 TWh solar, 1.0 TWh wind, 0.01 TWh bioenergy)

World renewable energy shares (2019): 13.8% of TES and 26.0% of electricity generation

Overview

The potential of Kazakhstan's RES is substantial, though the share of RES in total energy supply is currently low, varying between 1-2%. The share of RES in electricity generation was 3% in 2020, or over 10% if large hydropower is included. The country aims to generate 15% of its electricity from RES by 2030.

Currently over 130 RES facilities supply power to the grid with a total installed capacity of more than 2 GW, a 20-fold increase since 2011. Most RES is solar and wind. In addition, Kazakhstan has some 1.6 GW of large hydropower generating capacity.

Kazakhstan employed FiTs for several years, but began using auctions to determine tariffs for RES projects from 2018. Between that time and 2021, Kazakhstan organised auctions for over 1 700 MW of RES capacity, resulting in PPAs for 75 projects. Auction-based PPAs allow a project to sell all of its power to the designated centralised buyer of RES and benefit from prioritised dispatching.

A major challenge for increasing the share of RES is the lack of sufficient flexible generating capacity to help integrate it. It is also difficult for RES to compete without subsidies against tariffs for amortised conventional generators that do not fully take into account costs for upgrading, replacement and environmental impact, notably in the case of coal.

Renewable energy potential

Kazakhstan has considerable RES potential, most of which has yet to be developed. Technically feasible wind potential is estimated at 920 billion kWh/year. About half of the country has wind speeds of 4-5 metres (m) per second at a height of 30 m. The greatest wind potential lies in the Atyrau and Mangystau regions near the Caspian Sea, as well

as in the northern and southern parts of the country (USAID, 2021b). The Ministry of Energy and UNDP conducted a project funded by the Global Environment Facility (GEF) that produced a wind atlas of Kazakhstan in 2009, as well as a number of pre-investment studies to determine the detailed potential of 15 promising sites.

Figure 6.1 Wind energy potential

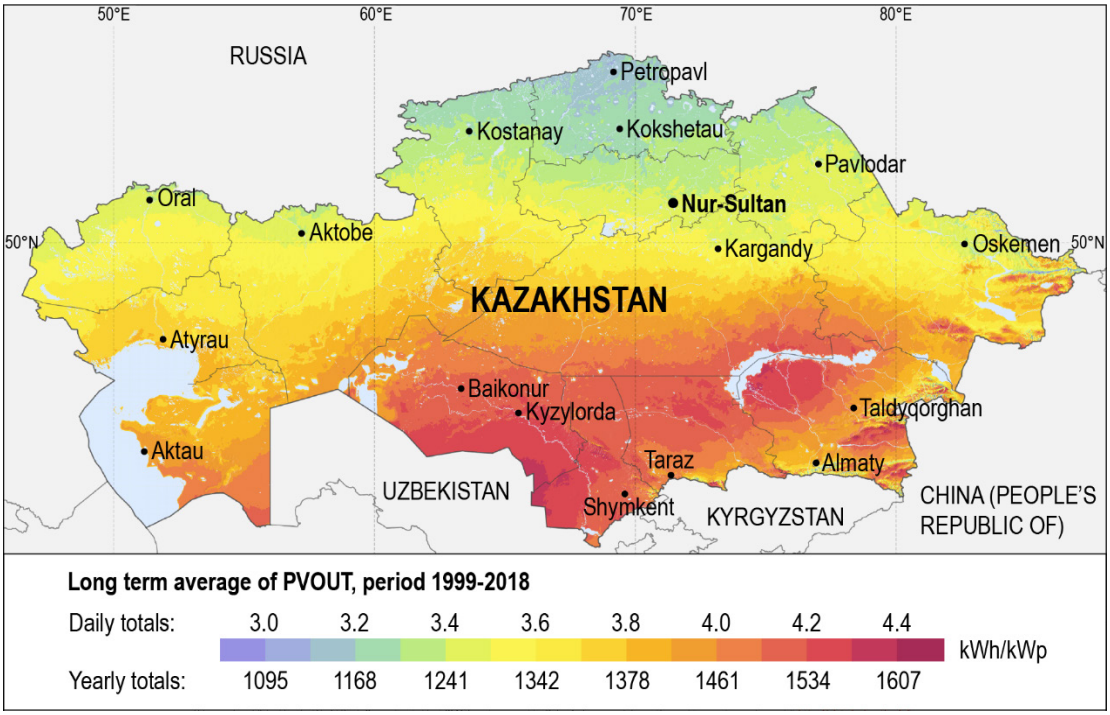
This map, adapted by the IEA, was obtained from the "Global Solar Atlas 2.0", a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info. The Works are licensed under the Creative Commons 4.0 Attribution International license, CC BY 4.0.

Source: World Bank (2020a), Global Wind Atlas: Kazakhstan, https://globalwindatlas.info/area/Kazakhstan

The estimated potential of hydropower resources is 170 billion kWh/year, of which about 62 billion kWh/year are considered technically feasible. Particularly promising areas for hydropower development are the Irtysh River basin in the north, the Ili River basin in the southeast, and the Syrdary, Tas, and Chus River basins in the south (USAID, 2021b).

Kazakhstan's potential for solar energy development is also considerable at 2.5 billion kWh/year. The country has an average of 2 200-3 000 hours of sun out of 8 760 hours per year, with 2 500-3 000 hours in the south (USAID, 2021b). The UNDP helped the Ministry of Energy develop a solar atlas of Kazakhstan in 2017.

Figure 6.2 Solar energy potential



This map, adapted by the IEA, was obtained from the "Global Solar Atlas 2.0", a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info. The Works are licensed under the Creative Commons 4.0 Attribution International license, CC BY 4.0.

Source: World Bank (2020b), Global Solar Atlas: Kazakhstan, https://globalsolaratlas.info/download/kazakhstan.

Geothermal resources have yet to be explored in detail but are potentially large. One estimate puts them at 97 billion tonnes of oil equivalent (toe), which would be on par with Kazakhstan's oil and gas resources (USAID 2021b). Around three-quarters of geothermal resources are thought to lie in the western part of the country, with additional resources in the southern and central regions.

Kazakhstan produces large amounts of waste from crops and livestock that potentially could fuel biogas plants. The European Bank for Reconstruction and Development (EBRD) is currently conducting a study to assess the potential for biofuel production (USAID, 2021b).

The International Renewable Energy Agency (IRENA) estimates Kazakhstan's net primary production (NPP) of biomass to be 1.5 tonnes of carbon per hectare per year (tC/ha/yr), which is below the world average of 3 tC/ha/yr to 4 tC/ha/yr (IRENA, 2021).[16]

The Ministry of Ecology, Geology and Natural Resources estimates that Kazakhstan produces about 4 Mt to 5 Mt of solid household waste annually, some 80% of which goes to landfills. The ministry has proposed the construction of waste-to-energy plants for the cities of Aktobe, Almaty, Ust-Kamenogorsk, Nur-Sultan, Karaganda and Shymkent to help eliminate much of the household waste currently going to landfills (Kazinform, 2021).

[16] NPP is the amount of carbon fixed by plants and accumulated as biomass each year, and as such is the sustainable amount that could be harvested.

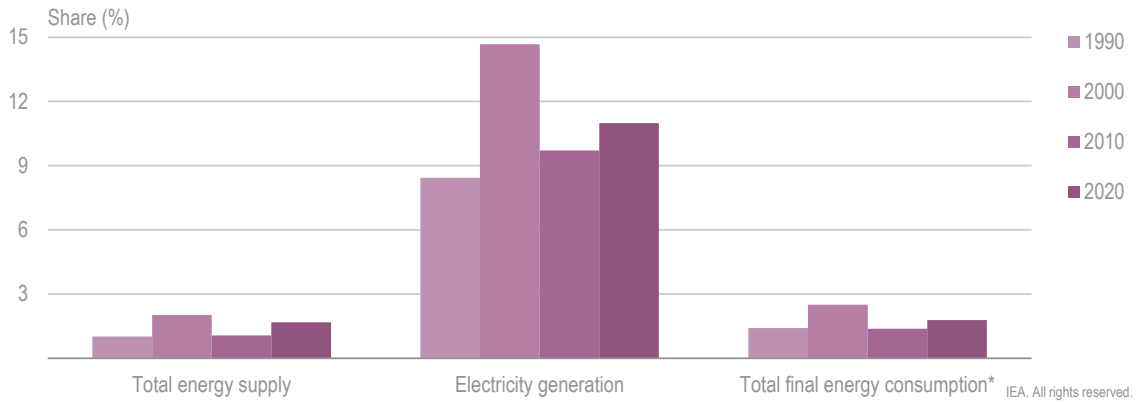
The grid operator, KEGOC, provides a tool called RE Explore on its website that allows potential investors to visualise different renewable energy development scenarios. It was developed with the assistance of the United States (US) National Renewable Energy Laboratory and the US Agency for International Development (USAID) (https://rfc.kegoc.kz/ru/resources/reexplorer).

Renewable energy supply and consumption

Renewable energy in total energy supply

The share of RES in Kazakhstan's TES is currently low, varying between 1% and 2%. The share of RES in electricity generation has averaged 10% of the total over the last decade, including large hydropower.

Figure 6.3 Renewable energy shares in Kazakhstan's energy system, 1990-2020

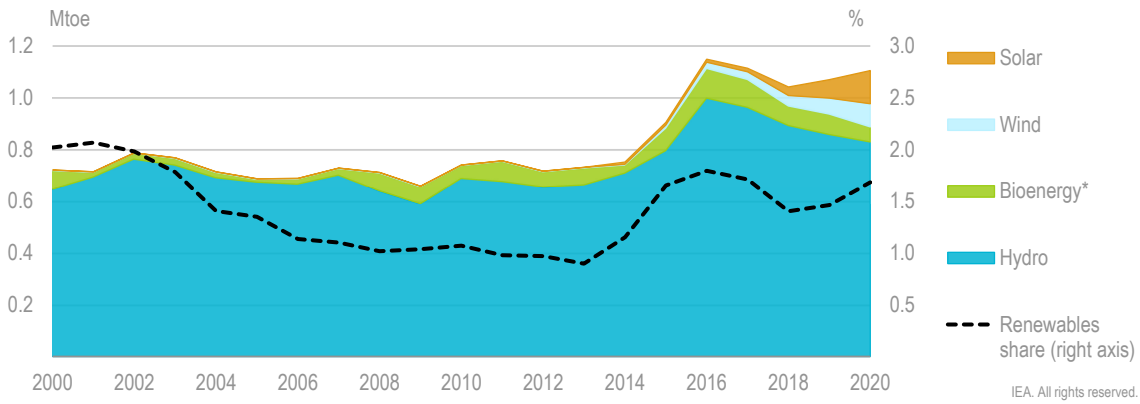


The share of renewables in Kazakhstan's energy system is low, below 2% of TES.

* Includes direct use in total TFC and indirect use through electricity and heat consumption.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 6.4 Renewable energy in Kazakhstan's TES, 2000-2020



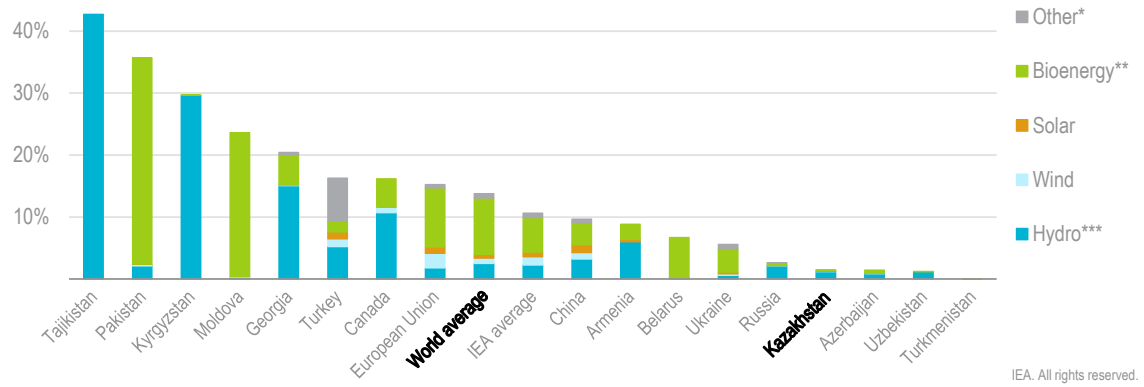
Large hydropower is the main source of renewable energy in Kazakhstan.

* Includes solid biofuels.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Hydropower is the main renewable energy source in use in Kazakhstan. Bioenergy (solid biofuels) is used mainly in the residential sector. Deployment of solar and wind has increased significantly since 2018.

Figure 6.5 Renewable energy share of TES in selected countries, 2019



The share of RES in Kazakhstan is below the world average but similar to others in the region.

* Includes geothermal, primary heat and wave and ocean energy.
** Includes, solid, liquid and gaseous biofuels and renewable waste
*** Excludes pumped storage.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Renewable electricity generation

As of December 2021, there were over 130 operating RES facilities in the power sector with a total installed capacity of more than 2 GW. This included 684 MW of wind capacity, 1 037.6 MW of solar PV capacity, 280 MW of capacity from small hydropower plants (SHPPs), and 8 MW from bioenergy plants (USAID, 2021a). This represents a 20-fold growth compared with the country's 94 MW of installed RES-based generating capacity in 2011.

In addition, Kazakhstan has some 1.6 GW of large (>35 MW apiece) hydropower capacity.

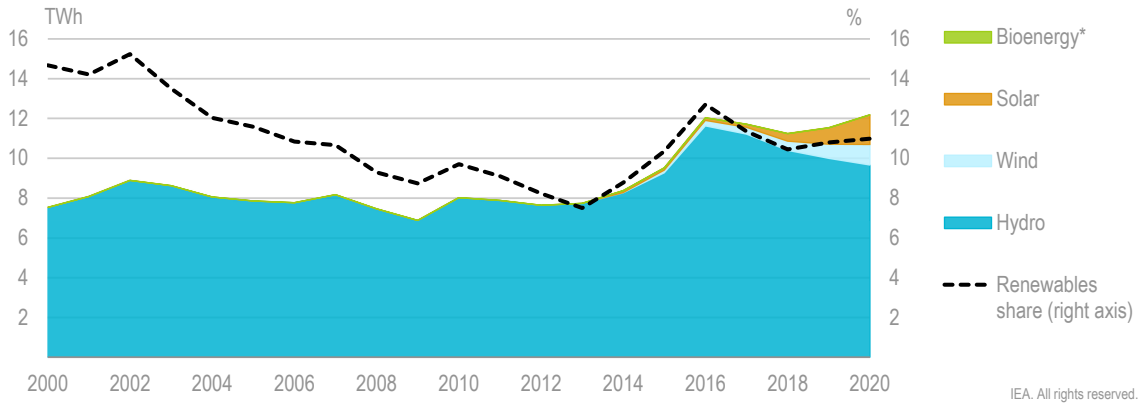
Table 6.1 RES capacity for electricity generation

Renewable energy type	Number of facilities (as of end-July 2021)	Total installed capacity (MW as of 1Q 2021)	Generation in 2020 (GWh)
Wind power plants	30	601.3	1 076.7
Solar power plants	47	1 032.6	1 349.7
SHPPs	39	255.1	812.1
Biogas power plants	5	7.8	6.6
TOTAL	**121**	**1 897**	**3 245.1**

Source: USAID (2021b).

RES generated over 4.2 TWh in 2021, accounting for about 3.7% of Kazakhstan's generated electricity that year, not including large hydro (Kazinform, 2022). This compares with 3.2 TWh or 3% of generation in 2020 (USAID, 2021a). If large hydro resources are included, generation by RES in 2020 was 12.2 TWh.

Figure 6.6 Renewable energy in Kazakhstan's electricity generation, 2000-2020

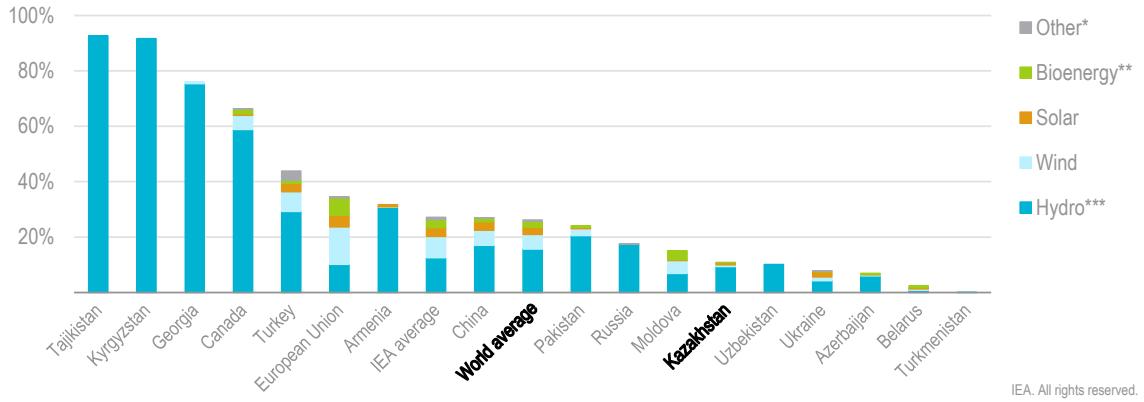


Generation from RES has become more varied by source since 2016.

* Negligible, not visible at this scale.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 6.7 Renewable energy share in electricity generation in selected countries, 2019



The share of RES in electricity generation is below the world average but expected to grow as solar and wind capacity is added.

* Includes geothermal, primary heat and wave and ocean energy.
** Includes, solid, liquid and gaseous biofuels and renewable waste.
*** Excludes pumped storage.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Institutional framework

The **Ministry of Energy** has overall responsibility for energy policy in the country, including for renewables. The ministry approves the annual schedule for the auction of RES generating capacity.

KEGOC operates and maintains the main electricity grid. It is required to connect all RES that have signed PPAs with the FSC, and to prioritise RES generation for dispatch.

The **FSC** is a subsidiary of KEGOC created in 2013 as the guaranteed single buyer and seller of RES.

KOREM conducts the auctions for new renewable energy capacity on behalf of the FSC.

Policies and measures

The 2013 Green Economy Concept calls for electricity generation from RES to reach 3% by 2020, 6% by 2025 and 10% by 2030. After Kazakhstan reached its 3% target in 2020, the government raised its 2030 goal from 10% to 15%. By 2050, the country aims to generate 50% of its electricity from "alternative or renewable" sources, which might include nuclear in addition to RES.

The first legislation supporting RES development in Kazakhstan was passed in 2009, followed by major amendments in 2013, 2017 and 2020.

In 2009, Kazakhstan created the FSC, which was empowered by government decree No. 1281 of 29 November 2013 to serve as a centralised buyer and seller of RES. The FSC is a subsidiary of the grid operator, KEGOC, which in turn is obliged to connect to the network all RES facilities that have PPAs with FSC and prioritise them in dispatching.

Government Resolution No. 645 of 12 June 2014 provided for guaranteed FiTs payable by FSC for different forms of RES for 15 years. While RES developed prior to 2018 still benefit from FiTs, amendments made in 2017 to the Law on the Support of the Use of RES required tariffs for RES developed from 2018 to be determined by auctions (see below). Amendments in December 2020 extended the length of tariffs determined by auctions from 15 years to 20 years.

Auction-based tariffs benefit from an annual adjustment beginning from the second year of generation. The adjustment is made according to an index that is based 70% on changes to the exchange rate, and 30% on Kazakhstan's consumer price index. The indexation of FiTs for PPAs signed prior to 2018 is based on the same components but with the opposite weighting. Protection against changes in the exchange rate is important for most RES projects, since much of the equipment must be imported and project loans are often denominated in foreign currency. While indexing helps alleviate some currency risk, RES project developers continue to consider risk of tenge depreciation one of the most important concerns for potential RES investors (PwC, 2021).

The FSC is obliged to purchase all electricity produced by RES with which it has concluded PPAs. RES producers are not responsible for paying for transmission services or for deviations from the supply schedule, which are instead the responsibility of the FSC.

RES-generated power supplied to the grid via the FSC is paid for by all producers and importers of conventional power in Kazakhstan, including large hydropower producers constructed prior to 2016. In the recent past these were required to purchase all RES-generated electricity on a pro rata basis according to the amount of conventional electricity they supply to the grid. In order to alleviate the growing financial strain on conventional generators, amendments in 2020 introduced a "pass-through" tariff that is added on top of the ceiling tariff for conventional electricity.

The 2020 amendments also reinforce the financial position of the FSC by making it possible for the government to provide financial assistance to the FSC in case it is unable to meet payment obligations to RES project developers (USAID, 2021a).

As of the end of 2021, the FSC had signed 161 contracts for 3 106 MW of RES capacity. This included 86 fixed-tariff contracts for a total of 1 800 MW and 75 contracts for 1 306 MW of projects whose tariffs were determined by auctions (KEGOC, 2021; USAID 2021a).

RES auctions

In 2017, the government assigned KOREM to conduct auctions for RES on behalf of the FSC, beginning in 2018. The amount of capacity auctioned each year is based on a schedule drawn up by the Ministry of Energy, which has been aiming to promote the construction of about 250 MW of RES per year. The goal of the auctions is to lower required tariffs while developing RES in a systematic way that ensures the integration of intermittent generating assets. KOREM has drawn on international best practice and experience in setting the rules for its RES auctions.

The annual auction schedule specifies the amount of capacity to be developed during a particular year by RES type and location (north, south and west zones). Auction participants are required to provide a financial guarantee of KZT 2 000 per kilowatt (kW) of installed capacity that they intend to bid for. The required guarantee rises to KZT 5 000 per kW in auctions for specific projects for which documentation, such as pre-investment studies, is provided. To be valid, an auction must have at least two bidders, and the received bids must total at least 130% of the offered capacity. All auctions are held online (USAID, 2021a).

The main criterion on which auction participants bid is the tariff. The ceiling prices for the first auctions were the then-current FiTs. Ceiling prices for auctions held in subsequent years are the maximum bids received for particular RES types at the previous year's auctions.

During the period 2018-2021, KOREM organised 41 auctions for a total of 1 710 MW. This resulted in 75 projects for a total of 1 305.72 MW, or about 76% of the capacity on offer. Wind accounted for the largest number of projects as well as the largest amount of capacity auctioned by type: 25 wind projects were selected for a total of 724.79 MW. Solar projects were the second most popular: Contracts for 20 solar PV projects were signed for a total of 436.5 MW. Some 22 small hydropower projects for a total of 123.88 MW and six bioenergy projects for a total of 20.55 MW were also selected to sign PPAs.

Table 6.2 Renewable energy auction results 2018-2021

		Wind	Solar	HPP	Bio	TOTAL
Installed capacity offered (MW)	2018	620	290	75	15	**1 000**
	2019	100	80	65	10	**255**
	2020	65	55	120	10	**250**
	2021	50	20	120	10	**200**
	Total	**835**	**445**	**380**	**45**	**1 705**
Projects selected (MW/No. of projects)	2018	500.85 / 16	270 / 12	82.08 / 7	5 / 1	**857.93 / 36**
	2019	108.99 / 5	86.5 / 3	7 / 2	10.4 / 3	**212.89 / 13**
	2020	64.95 / 3	60 / 4	23 / 9	0 / 0	**147.95 / 16**
	2021	50 / 1	20 / 1	11.8 / 4	5.15 / 2	**86.95 / 8**
	TOTAL	**724.79 / 25**	**436.5 / 20**	**123.88 / 22**	**20.55 / 6**	**1 305.72 / 75**

Source: USAID (2021a)

The first set of RES auctions, held in 2018, attracted 113 local and international companies from nine countries, including Kazakhstan, Bulgaria, China, France, Italy, the Netherlands, Russia, Turkey and the United Arab Emirates. Companies bid a total of 3 422 MW, which was over three times the 1 000 MW of capacity on offer that year. Contracts were signed for 36 projects for a total of 857.93 MW, or about 86% of the amount on offer. Although all of the 20 planned auctions were held, 7 were declared invalid due to a lack of the minimum number (2) of bidders.

Eight auctions were planned for and held in 2019, four for "large" projects and four for "small" projects. This included one for a large solar project of 50 MW, for which documentation had been developed under a UNDP/GEF initiative. Auctions in 2019 included the participation of 32 local and international companies from eight countries. Bids were received for a total of 818.99 MW, or over three times the 255 MW on offer. Contracts were signed with 13 projects for a total of 212.89 MW or about 85% of the capacity being offered.

Eight auctions were also planned and held in 2020, including four for small projects without documentation, two for large projects without documentation, and two for large projects with documentation. Auctions in 2020 included the participation of 27 local and international companies from four countries (Kazakhstan, Germany, the Netherlands and Russia). Bids were received for a total of 493.9 MW, or nearly twice the 250 MW of capacity being offered. Contracts were signed with 16 companies for a total of 147.5 MW, or about 60% of the capacity offered. Two of the auctions, for large HPPs and bioenergy, were considered invalid due to an insufficient number of bidders.

Five auctions were planned and held in 2021. Bids were received for 626.95 MW, or over three times the 200 MW on offer. Some 24 companies participated in the auctions that year, local. Contracts were signed with eight companies for a total of 86.95 MW, or about 43% of the capacity on offer. The auction for large hydro was declared invalid due to an insufficient number of bidders.

Table 6.3 Evolution of prices at renewable auctions

		Wind	Solar	HPP	Bio
Starting auction ceiling price (KZT/kWh)	2018	22.68	34.61	16.71	32.23
	2019	22.66	29.00	15.48	32.15
	2020	21.69	16.97	15.48	32.15
	2021	21.53	16.96	15.20	32.15
Minimum auction price (KZT/kWh)	2018	17.39	18.00	12.80	32.15
	2019	19.27	12.49	15.43	32.13
	2020	15.90	14.58	13.48	-
	2021	14.08	12.87	15.00	32.14

Source: USAID (2021a)

KOREM's RES auctions have been successful in reducing tariffs for all RES types except bioenergy. Table 6.3 provides an overview of the starting auction ceiling prices and minimum bids by RES type for each year. Solar PV achieved the greatest reduction (63%) between 2018 and 2021, probably due in part to reductions in the cost of solar PV panels worldwide over the period. Wind projects achieved a reduction of 38%, which was the second largest. Auctions for small hydropower projects obtained a 23% reduction during the first year, but some of this gain was reduced during subsequent years' auctions, resulting in a final reduction of 10% from the original FiT.

In recognition that more flexible capacity will be required to help balance the system and integrate an increasing amount of RES, KOREM began holding similar auctions for flexible gas-fired and large hydro capacity. The first such auctions took place in December 2021 and resulted in two gas-fired projects totalling 550 MW. KOREM plans to offer up to 1 240 MW in flexible capacity in auctions during 2022.

The government is also considering the need to require RES projects to include electricity storage as a way to help increase balancing capacity in the system. Under current arrangements, RES developers are paid for all of the power that they produce and bear no responsibility for planned amounts that they do not deliver, e.g. when the sun is not shining or wind is not blowing.

Investment preferences

The Entrepreneurial Code provides investment categories for different categories of projects, including “Investment Projects”, “Priority Investment Projects” and “Special Investment Projects”. A 2016 government resolution allowed RES projects to benefit from privileges reserved for “Investment Projects”, and a 2020 resolution further classified RES projects as “Priority Investments”.

Investment preferences for “Investment Projects” include exemption from VAT and customs duties for imported equipment, as well as the possibility to receive state in-kind grants for up to 30% of the investment in fixed assets, which could include grants of land, buildings or equipment. Priority investment projects benefit from additional preferences, including exemptions from corporate income tax and land taxes for ten years (USAID, 2021b).

Assessment

Kazakhstan has large RES potential, particularly wind and solar. The government has successfully used investment incentives and auctions to meet its target of generating 3% of electricity from RES by 2020, and appears on target to meet its next goal of 6% by 2025.

Integrating Kazakhstan’s growing RES capacity is increasingly becoming a challenge. Kazakhstan’s power system has a large amount of (mostly coal-fired) baseload capacity, but very little of the flexible capacity that can be quickly powered up or down in response to the intermittent nature of RES, e.g. when the sun does not shine or wind does not blow. In December 2021, Kazakhstan began using auctions similar to those for RES to attract investment in new flexible capacity, such as large gas-fired and hydropower projects. The IEA welcomes this initiative, which probably should be further expanded, including to replace the large number of inefficient coal-fired plants that not only are near the end of their useful lives but are challenging the ability of Kazakhstan to meet its climate and environmental goals.

The government has tasked KOREM with developing a balancing market. This was originally due to be launched in 2008, but was still in simulation mode as of the beginning of 2022. In the meantime, there appears to be little incentive for producers to sell more electricity during peak hours. A balancing market would help determine the amount of balancing capacity currently in the market, as well as stimulate the efficient development of new flexible generating capacity and storage. The IEA understands that a new launch

date for the capacity market has been set for some time in 2022. In the meantime, Kazakhstan effectively relies on power imports from Russia to balance its system and maintain frequency control.

One option for ensuring more flexibility in the system is electricity storage. Currently, most if not all RES projects in Kazakhstan do not include storage, such as batteries that could be charged while the sun is shining or wind is blowing and then fed into the grid during periods when the RES is not able to generate. There is currently no incentive for RES projects in Kazakhstan to include storage, since the auction rules do not require it and the resulting PPAs with the FSC absolve developers of any financial responsibility for balancing. Unfortunately, including storage would add significant costs to RES projects, in turn requiring tariffs that may be substantially higher than those currently in use.

Even without the cost of storage, it is difficult for RES to compete with existing conventional generation, which is why RES are being subsidised. However, tariffs for conventional power producers are apparently based on the short-term marginal costs of fully or nearly amortised assets and do not fully take into account long-run upgrade and replacement costs of those assets, let alone their environmental and climate externalities, such as pollution and GHG emissions. If such costs were fully taken into account in tariffs for conventional generation, RES probably would be in a substantially better position to compete with conventional generators, including in the development of flexibility/storage. The IEA understands that energy prices are a sensitive social issue in Kazakhstan. However, many countries have been able to address this through direct subsidies for the most vulnerable consumers.

Recommendations

The government of Kazakhstan should:

- Reduce the need for RES subsidies by ensuring that tariffs for conventional electricity generation take into account long-run marginal costs, including environmental costs.
- Continue and expand auctions to build RES and flexible capacity.
- Prioritise the development of an efficient balancing market in order to stimulate the efficient development and use of balancing capacity, which will be increasingly needed for the integration of RES.
- Include storage as part of future RES auctions, recognising that this will require higher tariffs to cover such costs.
- Support research, development and deployment of new, less expensive storage solutions for RES.

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7. Energy, environment and climate change

Key data

(2020)

Total GHG emissions without LULUCF: 342.9 $MtCO_2$-eq, -11.1% since 1990, +14.0% since 2010

GHG emissions without LULUCF by sector: Energy 79.5%, agriculture 11.9%, industrial processes 6.5%, waste 2.1%

Total GHG emissions with LULUCF: 351.2 $MtCO_2$-eq, -8.0% since 1990, +11.2% since 2010

Energy-related emissions:

Fugitive GHG emissions: 28.5 $MtCO_2$-eq, -59% since 1990, -1% since 2010

CO_2 emissions from fuel combustion: 204.4 Mt CO_2, -13.9% since 1990, -7.6% since 2010

CO_2 emissions by fuel: Coal 62.5%, oil 20.9%, natural gas 16.6%

CO_2 emissions by sector: Electricity and heat generation 50.9%, residential 14.5%, industry 14.0%, transport 10.1%, other energy 5.8%, services/other 4.7%

CO_2 intensity (CO_2 emissions per GDP): 0.45 kg CO_2 /USD (2015 PPP) (world average 2019 0.26)

Source: MEGNR (2022), *2022 National Inventory Report (NIR)* https://unfccc.int/documents/461955.

Overview

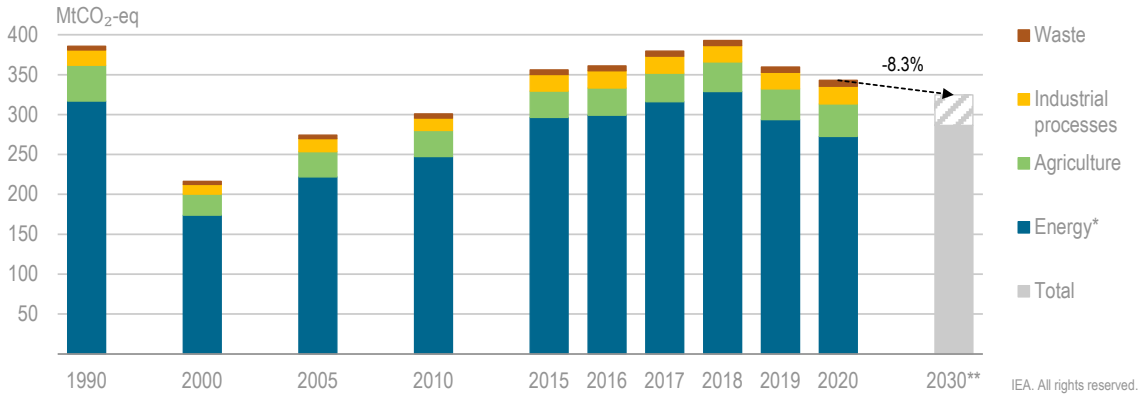
Kazakhstan joined the UNFCCC in 1995 and ratified the Kyoto Protocol in 2009. In 2016, it ratified the Paris Agreement and pledged to reduce its GHG emissions to 15% below 1990 levels by 2030 (including LULUCF) as an unconditional target, and by 25% conditional to receiving additional international assistance. Kazakhstan's 2021 Environmental Code requires state bodies to take actions aimed at ensuring the fulfilment of these targets.

In December 2020, President Tokayev announced that Kazakhstan aims to achieve net carbon neutrality by 2060. The government's modelling results have shown that this will need to be achieved through a significant decline in the share of fossil fuel resources in energy consumption and an increase in the use of renewables.

In 2020, Kazakhstan's net GHG emissions totalled 351.2 million tonnes of carbon dioxide equivalent ($MtCO_2$-eq), which was 8.3% over its 2030 target. CO_2 accounted for 81.6% of total GHG emissions in 2020, reflecting the country's significant dependence on coal combustion. According to Kazakhstan's latest national inventory report to the UNFCCC, energy-related emissions in 2020 accounted for around 80% of its total GHG emissions, excluding effects from land use.

In 2020, fuel combustion was the largest source (90%) of emissions from Kazakhstan's energy sector, while fugitive methane emissions accounted for the remaining 10%.

Figure 7.1 Kazakhstan's greenhouse gas emissions by sector, 1990-2020



Most of Kazakhstan's GHG emissions are from the energy sector.

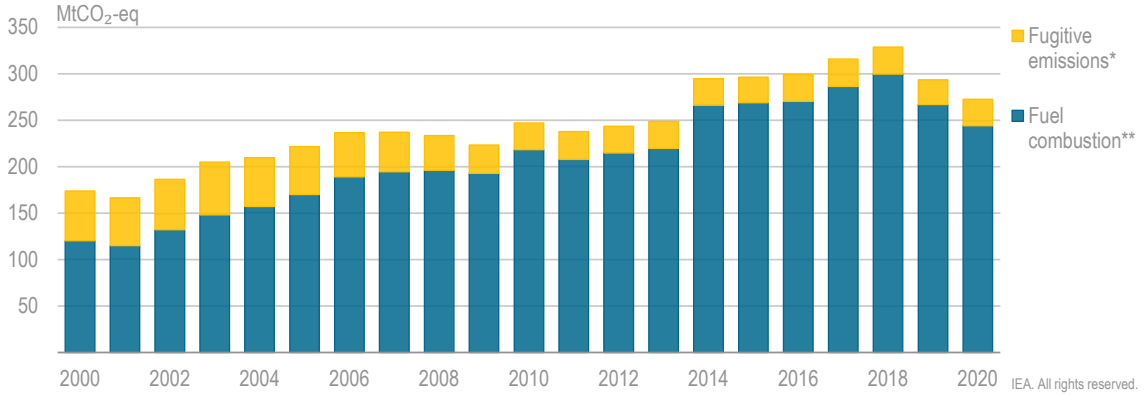
* Includes fuel combustion (for power and heat generation, and for industry, transport, residential and commercial energy consumption) and fugitive emissions from fuels.
** reflects the nationally determined contribution to reduce GHG emissions to 15% below 1990 levels by 2030 (full bar) and by 25%, which is conditional to receiving additional international assistance (grey bar)

Sources: MEGNR (2022), *2022 National Inventory Report (NIR)*. https://unfccc.int/documents/461955; MEGNR (2016). *Intended Nationally Determined Contribution of the Republic of Kazakhstan*. https://unfccc.int/sites/default/files/NDC/2022-06/INDC%20Kz_eng.pdf.

Energy-related GHG emissions

GHG emissions from the energy sector can be divided into those from fuel combustion and from fugitive emissions. In 2020, fuel combustion was the largest source (90%) of emissions from Kazakhstan's energy sector, while fugitive emissions accounted for the remaining 10%. During 2000-2020, GHG emissions from fuel combustion reportedly nearly doubled, while fugitive emissions fell by half.

Figure 7.2 Kazakhstan's energy-related GHG emissions, 2000-2020



Fugitive emissions make up almost 10% of Kazakhstan energy-related GHG emissions.

* Corresponds to GHG inventory category 1.B, "Fugitive emissions from fuels".
** Corresponds to GHG inventory category 1.A. "Fuel combustion (sectoral approach)".

Source: MEGNR (2022), *2022 National Inventory Report (NIR)*. https://unfccc.int/documents/461955.

Fugitive emissions

The substantial reduction in fugitive emissions since 2000 is attributed to reduced emissions from the oil and gas sector, including from flaring and venting, which fell from 27 $MtCO_2$-eq in 2000 to 5 $MtCO_2$-eq in 2020.

Kazakhstan's 2022 National Inventory Report (NIR) notes that the substantial decrease in fugitive emissions was due to the use of more advanced technologies in production, exploration and other processes. It also points out that, despite the growth in oil, gas and coal output, fugitive emissions have remained fairly stable since 2009, due mainly to a ban on flaring as well as an almost complete abandonment of underground coal mining.

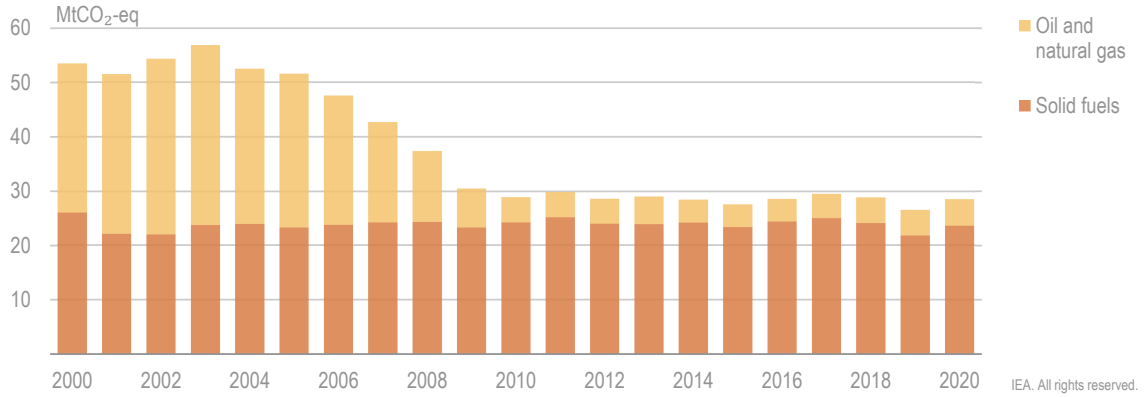
The Subsoil and subsoil use code prohibits flaring of raw gas, except for the following cases (Article 146): 1) threats or emergencies, threats to life of personnel or public health and the environment; 2) when testing well objects; 3) during trial operation of the deposit; or 4) with technologically inevitable combustion of raw gas (GoK, 2017).

According to Kazenergy (2021), Kazakhstan's flaring volumes were only 0.39 bcm in 2020, or 1.2% of total associated petroleum gas extraction. The World Bank reported that Kazakhstan reduced absolute flaring from 4 bcm in 2012 to 1.5 bcm in 2021, mainly due to strictly enforced regulations (World Bank, 2022a), and achieved a 62% reduction in flaring between 2012 and 2021 (World Bank, 2022c).

Kazakhstan is a partner in the World Bank's Global Gas Flaring Reduction Partnership. In 2015, KMG supported the partnership's initiative to completely phase out regular associated petroleum gas flaring by 2030 (KMG, 2022). As part of its implementation of this initiative, KMG approved an Emissions Management Policy in 2019 and that year reported a 97% utilisation rate of associated petroleum gas.

According to the 2022 NIR, 83% of fugitive emissions in 2020 were from solid fuels (primarily coal), and the remaining 17% from oil and natural gas. If methane emissions only are compared, the share is different (due to significant emissions of CO_2 from solid fuels, 17 Mt). Fugitive emissions generate 12 Mt CO_2-eq of methane emissions, out of which 59% from solid fuels and 41% from oil and natural gas.

Figure 7.3 Kazakhstan's fugitive emissions by energy source, 2000-2020



Most of Kazakhstan's fugitive emissions currently come from coal mining.

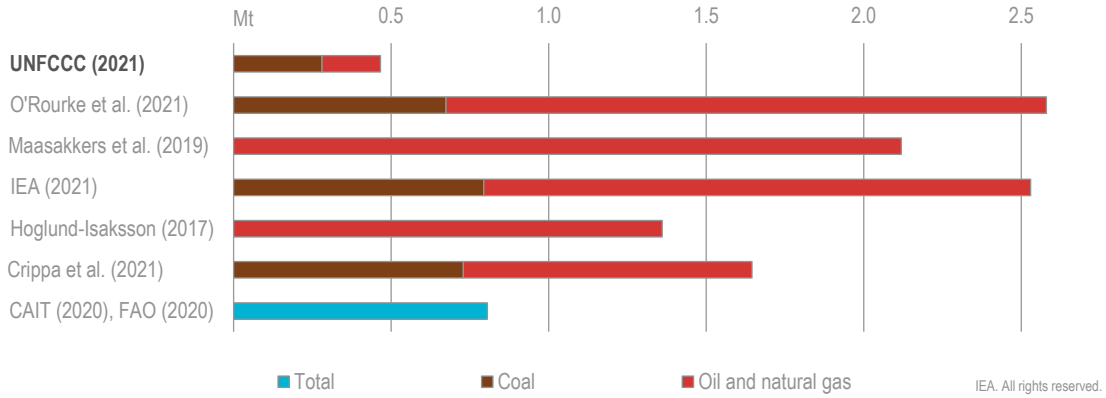
Source: MEGNR (2022), *2022 National Inventory Report (NIR)*. https://unfccc.int/documents/461955.

Note on data

In general, there are large differences between fugitive emissions data based on measurement campaigns and scientific studies, and emissions levels reported by official public bodies, such as to the UNFCCC. This mismatch exists at both global and national levels for all sources of emissions. The larger the hydrocarbon producer, the larger the difference can be. For Kazakhstan, the available literature values place the fugitive methane emissions from energy sources anywhere from 73% to over 400% higher than the official fugitive emissions reported to the UNFCCC.

Incomplete information about actual emissions levels and a lack of awareness about the cost-effectiveness of abatement is a key barrier to reducing methane emissions. In response, a growing number of recent initiatives aim to measure and report current and historical emissions from facilities, production types and countries. Yet these assessments remain incomplete – most countries and regions still have little or no measurement-based data, and the data they provide often require careful processing. These gaps highlight the need for robust and transparent data evaluation and harmonisation of estimates (IEA, 2022).

Figure 7.4 Kazakhstan methane emissions from energy sources, comparison with UNFCCC and other estimates



Source: IEA (2022), Methane tracker data explorer, https://www.iea.org/articles/methane-tracker-data-explorer#comparison-sources.

CO_2 emissions from fuel combustion

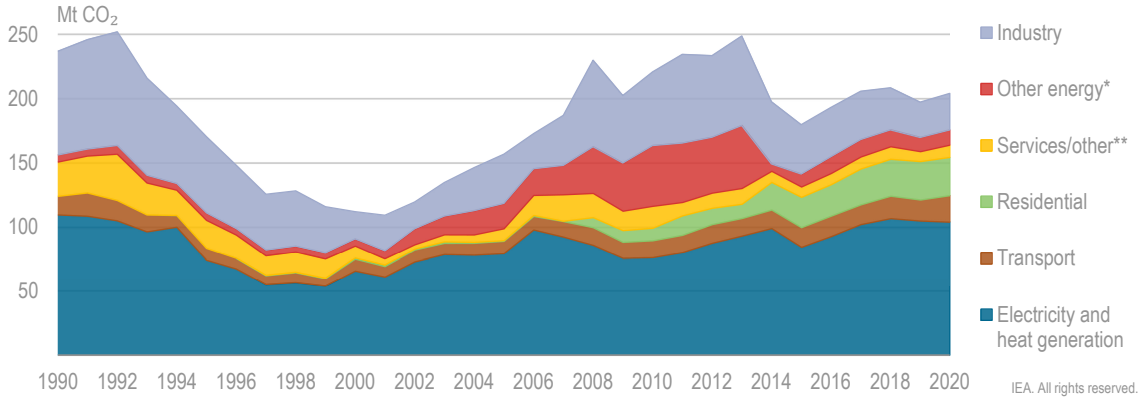
In 2020, Kazakhstan's CO_2 emissions from fuel combustion were 204.4 Mt CO_2, down 8% from the level of 2010. Electricity and heat generation accounted for 51% of the total. This high share is explained by the fact that around 70% of electricity generation is coal-based. Residential (15%) and industry (14%) emissions have the next highest shares, followed by transport (10%). The remaining 10% is emitted by the energy sector itself, and by services and agriculture.

There were structural changes in emissions during 2010-2020. Electricity and heat generation emissions increased by 36% in 2020 compared to 2010, while emissions from industry declined by over 50%. An increase in emissions in the electricity and heat generation is related to an increase in coal consumption. Emissions from the residential sector increased considerably, over threefold (such an increase in the emissions from the residential sector could be partially related to improved statistical reporting in the residential sector). Due to development of gas pipeline infrastructure and increased access to network gas, the share of households using coal in the residential sector appears to be gradually declining.

Completion of the Saryarka gas pipeline in 2019 may lead to a switch from coal to gas in a number of sectors that can result in a decline in emissions in the coming years. For example, in Nur-Sultan and Almaty, it is planned to convert CHPs from coal to gas and switch from coal to gas in households. In contrast, development of the construction sector in Kazakhstan (new buildings) and high demand for heating due to cold winters could result in increased emissions, indicating the need for relevant policies and measures, as well as enforcement and control, to promote energy efficiency and clean heating in buildings (as indicated in the Energy Efficiency chapter).

Emissions are estimated based on sectoral energy consumption data. Since some of the historical data may not be compliant with current calculation standards (Intergovernmental Panel on Climate Change guidelines), apparent sectoral emission trends may be misleading, particularly for industry.

Figure 7.5 Kazakhstan's CO_2 emissions from fuel combustion by sector, 1990-2020



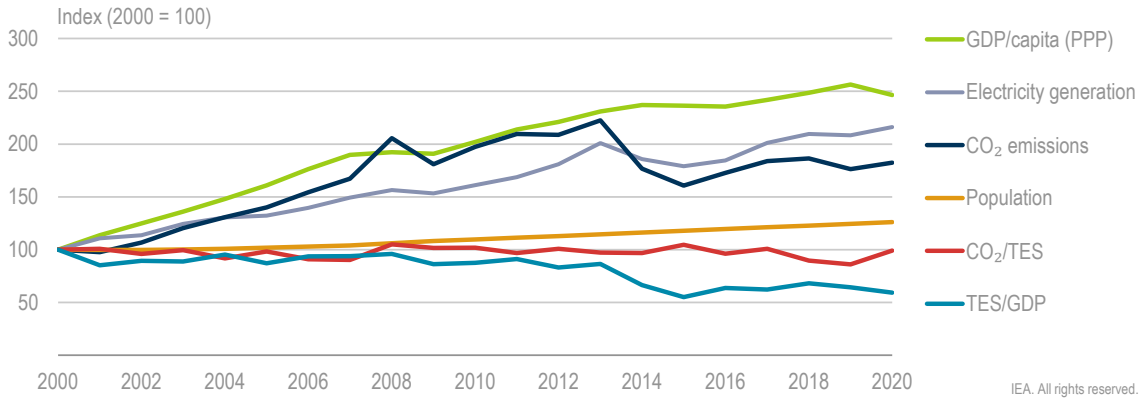
Electricity and heat generation – which is mainly coal-based – is responsible for over half of Kazakhstan's CO_2 emissions.

* Includes emissions from coal mines, oil and gas extraction, coke ovens, oil refineries, own use in electricity and heat generation, and unspecified energy industry own use.
** Includes commercial and public services, agriculture, forestry and unspecified energy consumption.

Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

A country's CO_2 emissions are often determined by population changes and economic activity. Emissions are also affected by the energy intensity of the economy and the carbon intensity of the energy supply. In Kazakhstan, total CO_2 emissions from fuel combustion have increased by 82% since 2000. In the same time period, the economy (measured per capita) has grown by +247%. The emissions increase is mostly a result of increased coal-fired electricity generation, as well as increased emissions from transport, the residential sector and services. Despite a certain decline in the energy intensity of the economy and the carbon intensity of the energy supply, an increase in emissions indicate that energy efficiency and decarbonisation efforts were not sufficient to counter the growth in economic activity. Further economic growth could lead to an increase in emissions if further efforts in energy efficiency and decarbonisation are not taken.

Figure 7.6 Energy-related CO_2 emissions and main drivers in Kazakhstan, 2000-2020



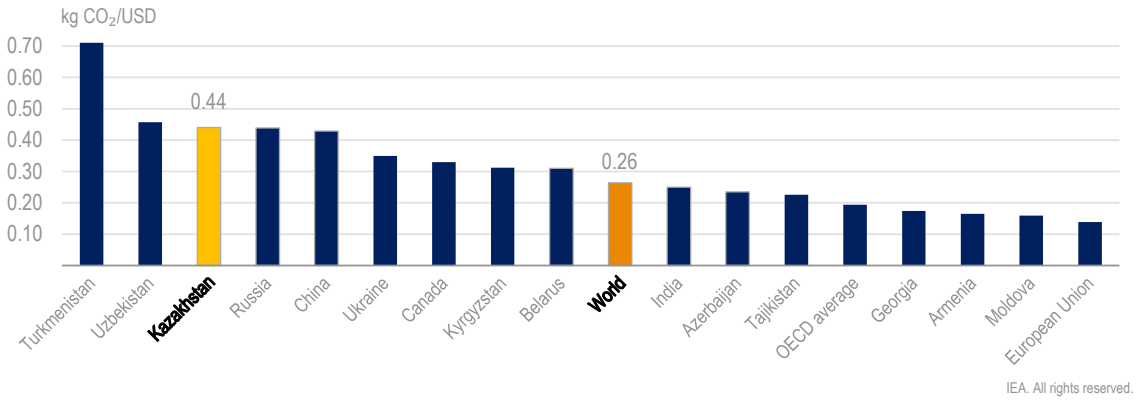
CO_2 emissions from fuel combustion have grown over 80% since 2000.

Note: GDP in constant USD 2015 prices and PPP (purchasing power parity).

Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

Kazakhstan's CO_2 intensity of GDP in 2019 was 0.44 kg CO_2/USD (2015 PPP). This is higher than the world average and reflects the role of energy-intensive heavy industries in the economy, as well as the reliance on coal in electricity generation.

Figure 7.7 CO_2 intensity in Kazakhstan and selected countries, 2019

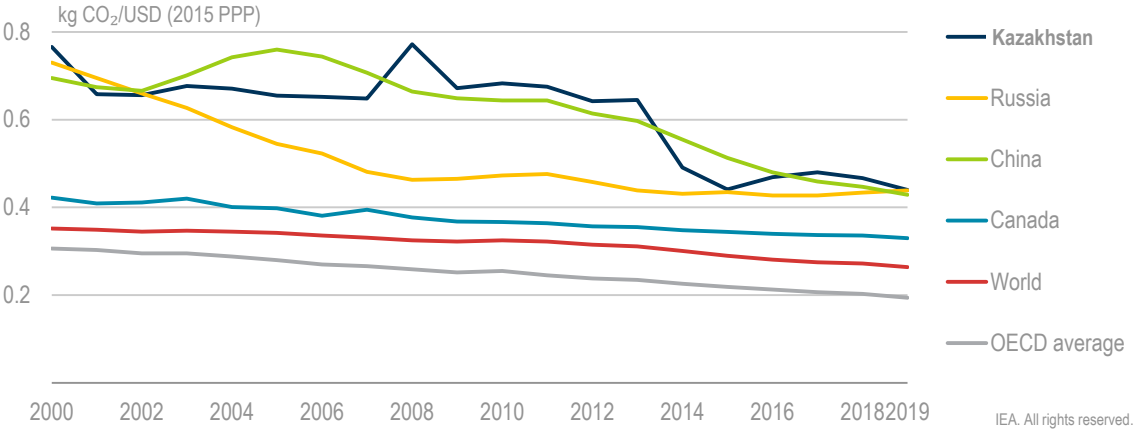


The CO_2 intensity of Kazakhstan's economy is nearly double the world average.

Notes: OECD = Organisation for Economic Co-operation and Development. Real GDP in USD 2015 prices and PPP.

Source: IEA, *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

Figure 7.8 CO_2 intensity in Kazakhstan and selected countries, 2000-2019



Although still very high, the CO_2 intensity of Kazakhstan's economy has declined substantially since 2000.

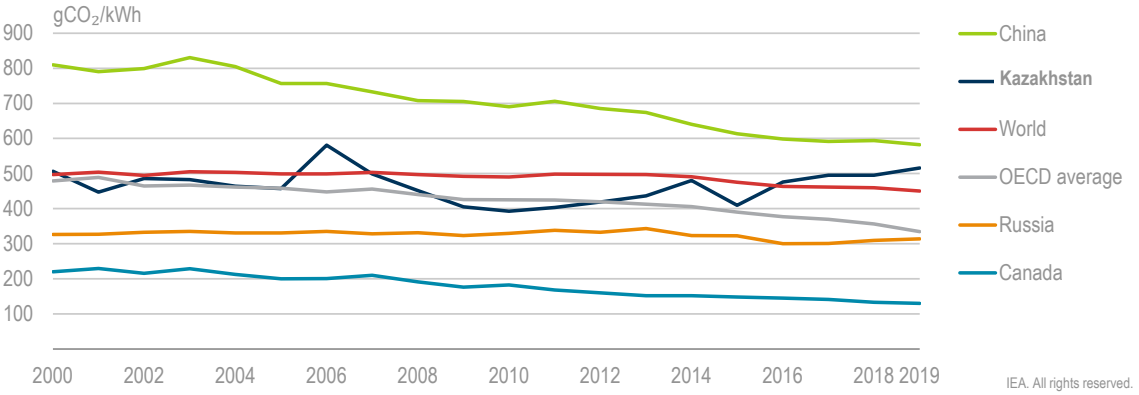
Source: IEA, *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

In 2019, Kazakhstan's power sector emitted an average of 516 grammes (g) of CO_2 per kilowatt-hour of electricity. The carbon intensity of power generation in Kazakhstan rose from 507 g CO_2/kWh in 2000 to 516 g CO_2/kWh in 2019, an increase of 2%. The relatively high carbon intensity reflects the high share (67% in 2020) of coal in power generation. Emissions from power generation could be reduced by increasing plant efficiency, using renewable energy sources, and/or by switching from coal to gas.

In selected countries/regions, the carbon intensity of power generation has fallen. For example, in China the carbon intensity of power generation fell from 810 g CO_2/kWh in 2000 to 582 g CO_2/kWh in 2019; the world average carbon intensity of power generation declined from 497 g CO_2/kWh in 2000 to 451 g CO_2/kWh in 2019; and the OECD average

carbon intensity of power generation declined from 479 g CO_2/kWh in 2000 to 335 g CO_2/kWh in 2019. In contrast, the carbon intensity of power generation in Kazakhstan rose from 507 g CO_2/kWh to 516 g CO_2/kWh over the same period, an increase of 2%. Such an increase is attributed to increased coal consumption for heat and power generation, despite some increase in gas and RES.

Figure 7.9 CO_2 intensity of power and heat generation in Kazakhstan and selected countries, 2000-2019



The CO_2 intensity of power and heat generation in Kazakhstan is very high compared with OECD countries, but around the world average.

Source: IEA, *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

Institutions

The **Ministry of Ecology, Geology and Natural Resources (MEGNR)**, which took its current form in 2019, is responsible for environmental protection policy, climate policy, "green economy" development and waste management, among other issues.

MEGNR's Department of Climate Policy and Green Technologies is responsible for climate policy and the implementation of UNFCCC-related commitments and other international agreements and protocols in the field of climate change and the ozone layer.

JSC **Zhasyl Damu** is a subordinate organisation of MEGNR responsible for developing and maintaining Kazakhstan's GHG emissions inventory and for managing the country's system for regulating and trading GHG quotas.

The **working group**[17] to develop the Concept of low-carbon development of Kazakhstan until 2050 was formed in 2020 and is headed by the deputy prime minister.

In 2021, the **Ministry of National Economy** was made responsible for the country's long-term carbon-neutral development, at which point it established the "Project office for the transition to carbon neutrality and the organisation of the process of finalising the Strategy for achieving carbon neutrality of the Republic of Kazakhstan until 2060".

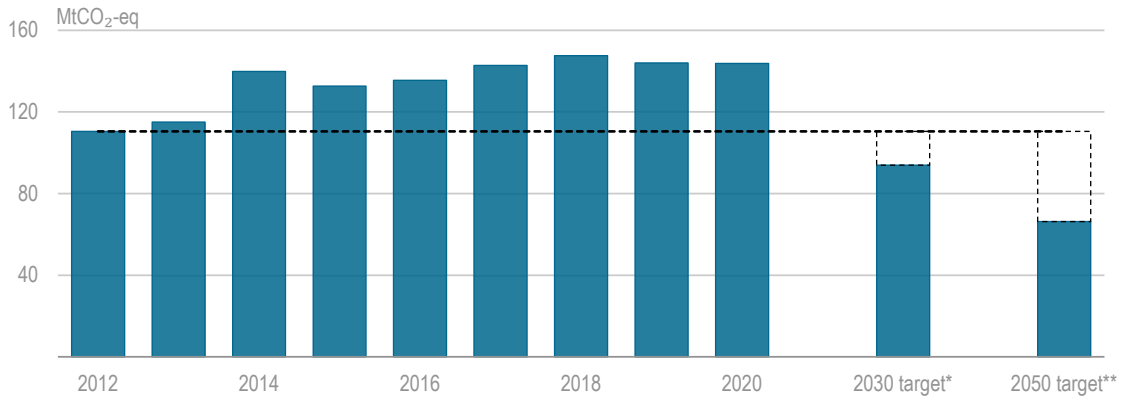
[17] The full name is the "Working group to develop the Concept of low-carbon development of Kazakhstan until 2050, including measures for 'green growth' and deep decarbonization of the national economy" (https://adilet.zan.kz/rus/docs/R2000000162).

Policy

Kazakhstan's 2015 NDC states that its GHG emissions reductions will be achieved by the implementation of the Green Economy Concept and adoption of related legislative acts intended to promote the modernisation of key infrastructure and the production base, based on energy-efficient technologies. The NDC outlines key laws, such as "On Energy Saving and Energy Efficiency" and "On Supporting the Use of Renewable Energy Sources", which aim to create favourable conditions for the adoption of RES and energy-efficient technologies. An NDC implementation roadmap has been developed but not yet approved.

In 2013, Kazakhstan adopted the Green Economy Concept. This includes targets for 2020, 2030 and 2050 in several areas, including water resources, agriculture, energy efficiency, the power sector, air pollution and waste recycling. One notable target is for a 15% reduction in CO_2 emissions in electricity production by 2030, and a 40% reduction by 2050 from the level of 2012. In 2012, CO_2 emissions from energy industries were 110 Mt CO_2-eq. and this increased substantially, reaching 144 Mt CO_2-eq. in 2020. The 2030 target is 94Mt, which was exceeded by 53% in 2020. The Green Economy Concept goal on CO_2 emissions reduction is highly unlikely to be achieved by 2030, unless urgent measures are taken within the remaining period to reduce coal use in power generation. In the power sector, the aim is for the share of "alternative" energy sources (including solar, wind and nuclear) in electricity production to reach 30% by 2030, and 50% by 2050. As described in the Renewable energy chapter, Kazakhstan reached its 2020 target for producing 3% of power from RES by 2020. It is planned for the share of RES to reach 6% by 2025 and 15% by 2030. The possible construction of a nuclear power plant is also being discussed (see Electricity chapter). In 2020, the "Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to a 'Green Economy' for 2021-2030" was adopted.

Figure 7.10 CO_2 emissions from the energy industries (fuel combustion), Mt CO_2-eq.



* 15% below 2012 emission level; **40% below 2012 emission level.

Sources: MEGNR (2022), 2022 National Inventory Report (NIR). https://unfccc.int/documents/461955.

Draft updated NDC

Kazakhstan made available its updated draft NDC for public discussion in September 2021 (GoK, 2021c). The draft has the same GHG emissions reduction targets as the first NDC

and states that, at Kazakhstan's current stage of development, it will not be able to raise its ambitions to reduce GHG emissions further. It notes that Kazakhstan needs to mobilise an additional investment of USD 293.5 billion for the implementation of decarbonisation measures, such as introduction of BAT, energy efficiency improvements, and construction of new renewable energy facilities. Modelling results in the draft indicate that to reach the country's 2030 target, the structure of electricity production would have to change as follows between 2020 and 2030:

- decrease in the share of coal from 68.9% to 40.1%;
- increase in the share of renewable energy sources (including large hydro) from 11% to 32.7%; and
- increase in the share of gas thermal power plants from 20% to 25%.

As described in the draft updated NDC, tighter regulation of emissions by large emitters under the ETS would lead to an estimated increase in the price of carbon units from USD 1.1 in the first phase of the NDC to USD 50.8 in the third phase. For small emitters not covered by ETS, a carbon tax on energy resources will be introduced. As of May 2022, the draft updated NDC had not yet been approved. In the meantime, it is planned to revise it in line with the Doctrine (Strategy) to achieve carbon neutrality by 2060.

Emissions trading scheme

Kazakhstan is the first FSU country to launch an emissions trading scheme (ETS). Kazakhstan's ETS was first introduced in the Environmental Code in 2011, and regulation of GHG emissions started in 2013, beginning with one year of operation in pilot mode.

There have been several phases of trading under the ETS: Phase I (2013), Phase II (2014-2015), Phase III (2018-2020) and Phase IV (2021). Kazakhstan's ETS regulates only CO_2 emissions and is applicable to large entities whose annual emissions exceed 20 000 tonnes (t) of CO_2 (World Bank, 2021). Sectors covered include power, centralised heating, extractive industries, and manufacturing. In accordance with Article 291 of the Environmental Code (GoK, 2021a), the number of units of carbon credit for installations subject to free distribution is calculated by applying benchmarks that specify specific volumes of emissions per unit of production.

In February 2018, the World Bank and the Ministry of Energy of Kazakhstan launched an online platform for the monitoring, reporting and verification system that is a critical component of Kazakhstan's ETS. This platform enables the country's major emitters to record and transmit emissions data online.

The free quotas are distributed by MEGNR. In case a company exceeds its quota, it may buy credits from other companies on the Commodity Exchange. The table below summarises trading information for the period 2014-2020. As can be observed, the number of transactions has been low and the average CO_2 price around USD 1/t. An important reason for both the low volume and low price is probably the large number of quotas distributed free of charge. With the adoption of the new Environmental Code, which entered into force on 1 July 2021, the government is planning to reduce the number of free quotas, though as of May 2022, the National Allocation Plan for 2022-2025 had not yet been published.

Table 7.1 Trading of quotas for greenhouse gas emissions in the Republic of Kazakhstan

Trading period	2014-2015	2018-2020	2020
Number of transactions, units	75	3	6
Volume of transactions, t CO_2	3 255 211	1 202 209	1 591 000
Volume of transactions, tenge	936 824 603	519 104 500	810 920 000
Average price for 1 t CO_2, tenge	287.79	431.79	510.00
Average price for 1 t CO_2, USD (exchange rate as of 15 May 2022)	0.7	1.0	1.2

Note: According to Zhasyl Damu JSC of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan. There was no trade in 2013 pilot year.

Source: BNS (2021), *Environmental protection in the Republic of Kazakhstan 2016-2020*, Statistical Publication, https://stat.gov.kz/edition/publication/collection.

Kazenergy (2019) has commented that a further problem with the Kazakhstan ETS is that its benchmark emissions intensity for coal-based electricity was set very high at 0.985 t CO_2/MWh (see MEGNR, 2021a), providing little incentive for coal-fired power plants to reduce their GHG emissions. In contrast, the benchmark for electricity generated from fuel oil and natural gas was set much lower at 0.621 t CO_2/MWh, potentially providing a disincentive for power generators to switch from coal to gas.

New Environmental Code 2021

In January 2021, Kazakhstan adopted a new Environmental Code (GoK, 2021a), which came into force in July 2021. Among its new features, it introduces policies to support the introduction of BAT. According to the new code, enterprises designated as Category-I (most polluting, with gross emissions of 1 000 t or more[18]) must obtain an Integrated Environmental Parmit (IEP). To obtain an IEP, a facility must prepare and follow a "programme for improving environmental efficiency" for introducing relevant BAT (according to government-approved BAT reference books) in order to achieve the specified range of emissions. The Environmental Code requires an IEP for all Category-I facilities (Art. 111), which must introduce relevant BAT within ten years. In the meantime, such facilities must be following their approved programme to achieve BAT in order to maintain their IEP.

The tax rates for emissions of 16 pollutants (SO_x, NO_x, dust, CO, etc.) from stationary sources are determined by the Tax Code (Article 576). The advantage of having an IEP is that it absolves a facility from paying environmental taxes, while pollution taxes are to be increased for facilities that are required to have an IEP but have not obtained one.

For energy-producing organisations (Category I) there are substantially reduced coefficients on pollution taxes payable, compared to the situation for other types of enterprises. For example, for Category-I enterprises that do not produce power and heat, progressively increased pollution taxes will apply from 2025 for the top 50 polluters, and from 2031 for those not in the Top 50. In contrast, for Category-I energy-producing organisations, increased coefficients (2.4) on tax rates for not having an IEP are to apply only from 2031 for those in the Top 50, and from 2037 for the rest. Smaller energy-producing organisations (category II and category III) which do not have an IEP will have the same reduced coefficient applied to the tax rates (0.3). Since smaller utilities and

[18] Gross emissions are the sum of all pollutant emissions (MEGNR, 2021b).

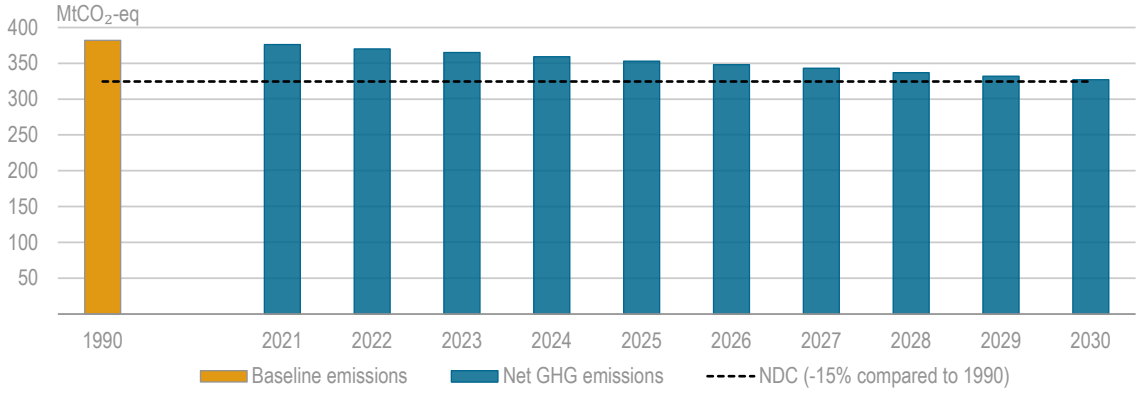
energy-producing organisations pay very relatively less pollution tax compared to other types of enterprises, they presumably have less incentive to obtain an IEP, adopt BAT, or reduce emissions.

The International Center for Green Technologies and Investment Projects (ICGTIP) is developing the official BAT reference books (BREFs) and serving as the "BAT Bureau". As stated by the MEGNR, Kazakhstan's BAT reference books will not be in line with those of the European Union, but "adjusted" to local conditions. This has been interpreted to mean that BAT standards are likely to be less stringent in Kazakhstan than they are in the European Union.

The BREFs are expected to be ready by the end of 2023. In the first stage of BAT (from 2025), Kazakhstan's 50 largest enterprises, which account for about 80% of pollution, will be required to have programmes to introduce BAT in order to obtain an IEP certificate.

Another important feature of the new Environmental Code is the requirement for Category-I facilities to use an "automated system for monitoring emissions into the environment" that provides data transfer to the "information system for monitoring emissions into the environment" in real time. The Environmental Code also introduces a "carbon budget" (Article 286), which has been developed with reference to Kazakhstan's international commitments. The carbon budget establishes a maximum level of net carbon emissions for the country. This in turn determines the volumes of allowable ETS and non-ETS emissions. For the period 2021-2025, the carbon budget is to be reduced annually by 1.5% from the level of 1990. For 2026-2030, the carbon budget for each calendar year has been estimated by assuming a reduction of at least 1.5% of the carbon budget from the previous year. For future carbon budgeting periods (from 2031), the carbon budget for each calendar year is assumed to be 15% below the 1990 level.

Figure 7.11 Carbon budget, Mt CO_2-eq (Net GHG emissions)



Sources: MEGNR (2022), 2022 National Inventory Report (NIR), https://unfccc.int/documents/461955.

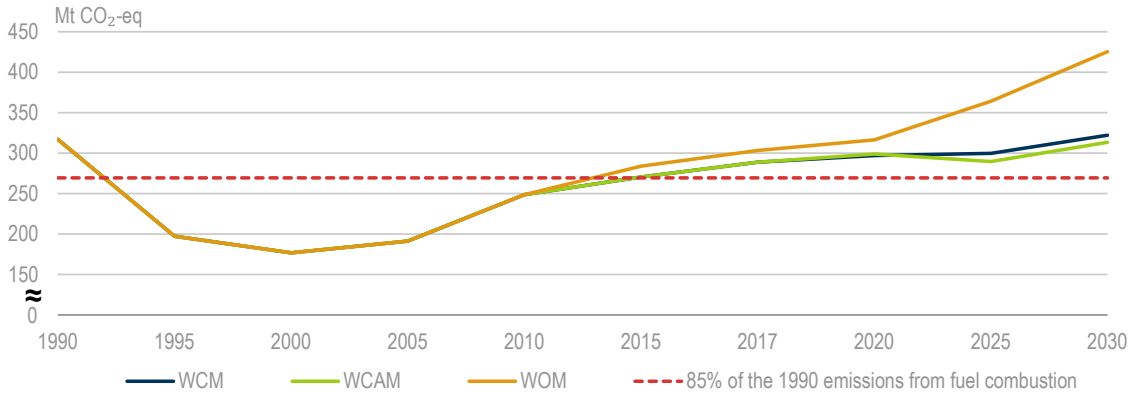
Projections of GHG emissions reported in the Fourth Biennial Report of Kazakhstan

Projections of GHG emissions for Kazakhstan were presented in the country's Fourth Biennial Report to the UNFCCC, submitted in 2019 (MEGNR, 2019). The TIMES model (The Integrated MARKAL-EFOM System) was used to estimate GHG emissions through 2030. Three scenarios were analysed: a scenario without measures (WOM); a scenario with current measures (WCM); and a scenario with current and additional measures

(WCAM). The WCM scenario envisages measures such as gasification of heat and power plants, developing renewable energy power plants, and increasing energy efficiency. The WCAM scenario includes more ambitious measures, such as doubling renewable energy capacity by 2025 and by 2030 compared with the renewable capacities assumed in the WCM scenario.

In the WOM scenario, which is "business as usual", GHG emissions from fuel combustion increase from 303.3 $MtCO_2$-eq in 2017 to 425.6 $MtCO_2$-eq in 2030. In the WCM scenario, GHG emissions from fuel combustion reach 322.3 $MtCO_2$-eq in 2030, and in the WCAM scenario they reach 313.3 $MtCO_2$-eq. A modelling exercise conducted for Kazakhstan's Fourth Biennial Report indicated that, despite emissions reductions in the WCM and WCAM scenarios, they both would fail to achieve the country's NDC target of 269.5 $MtCO_2$-eq for fuel combustion, which is 85% of the 1990 level. However, this modelling, which was conducted during 2018-2019, was not able to consider more recent developments, such as the 2060 carbon neutrality goals announced by President Tokayev in December 2020. Additional recent developments that were not considered in that exercise include COVID-19 lockdown measures in 2020 (resulting in lower emissions levels), the rise in the planned share of renewable energy sources in electricity generation by 2030 from 10% to 15%, completion of the Saryarka gas pipeline in 2019, and recent discussions around the possible construction of a nuclear power plant.

Figure 7.12 Projections of GHG emissions from fuel combustion, 1990-2030



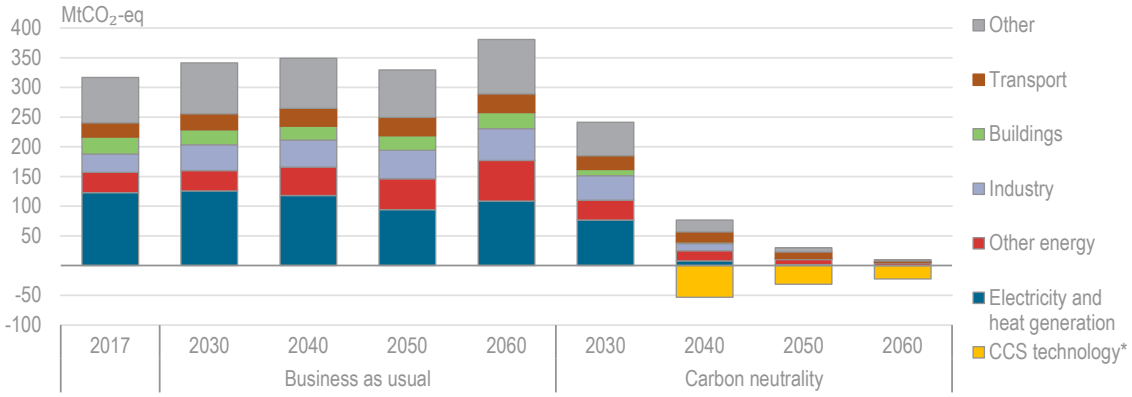
Source: MEGNR (2019). *Fourth Biennial Report of the Republic of Kazakhstan to the UNFCCC*. https://unfccc.int/documents/271261.

Draft Doctrine (Strategy) to achieve carbon neutrality by 2060

During 2019-2021, the German Agency for International Cooperation (GIZ) helped Kazakhstan develop the **Draft Concept of Low-Carbon Development until 2050**. The concept describes the potential for the reduction of GHG emissions in Kazakhstan and the requirements for technological solutions and investments in key sectors. As part of this, six scenarios were developed.

In 2020, President Tokayev announced Kazakhstan's plan for achieving climate neutrality by 2060. In this context, MEGNR initiated revisions to the Draft Concept mentioned above, transforming it into the Draft Doctrine (Strategy) of Achieving Carbon Neutrality of Kazakhstan until 2060. The six scenarios of the Draft Concept were reduced to two in the Draft Doctrine (Strategy): business as usual (an extrapolation of historical trends) and carbon neutrality, while the time periods covered by both were extended to 2060.

Figure 7.13 GHG emissions from fuel combustion scenario

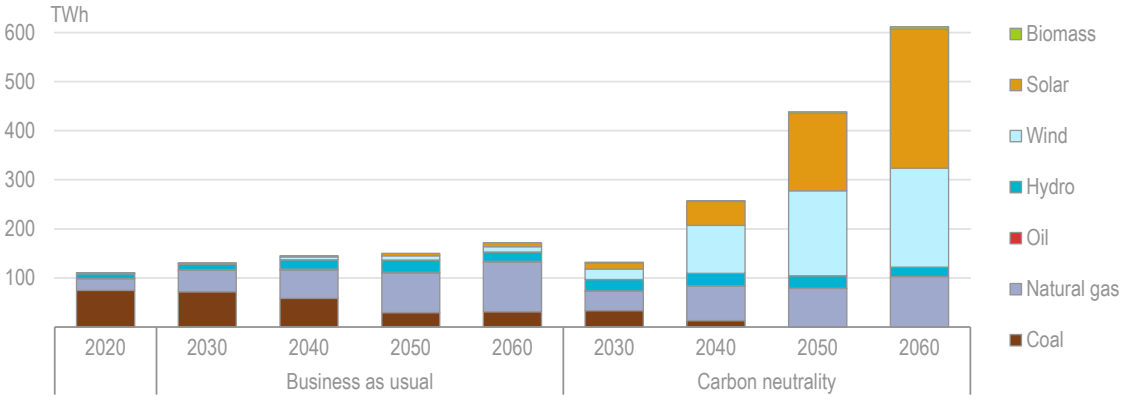


* Includes CCS for both electricity and heat generation and for industry.

Note: CCS = carbon capture and storage.
Source: Draft Doctrine (Strategy) to achieve carbon neutrality by 2060 (2021). *Draft Decree of the Prime Minister of the Republic of Kazakhstan*. https://legalacts.egov.kz/npa/view?id=11488215.

In October 2021, the MEGNR presented the Draft Doctrine (Strategy)**.** For assessing the transition to carbon neutrality, three models were employed: The TIMES energy system model, Computable General Equilibrium model, and Systems Dynamics Model (GoK, 2021b). The carbon neutrality scenario requires that the conditional NDC target of a 25% emissions reduction from the 1990 level be achieved by 2030 and a zero-emission economy-wide balance by 2060. It also requires that unavoidable GHG emissions will either be captured and stored or captured in carbon sinks such as vegetation and soils.

Figure 7.14 Electricity generation projections by scenario, 2030-2060



Source: Draft Doctrine (Strategy) to achieve carbon neutrality by 2060 (2021), *Draft Decree of the Prime Minister of the Republic of Kazakhstan*, https://legalacts.egov.kz/npa/view?id=11488215.

In the business-as-usual scenario, GHG emissions from fuel combustion in 2030 reach 381 $MtCO_2$-eq, an increase of 14% from 1990 levels. In the carbon-neutrality scenario, emissions from fuel combustion decline to 230 $MtCO_2$-eq in 2030, and to 10 $MtCO_2$-eq in 2060, which would be a 97% reduction compared with 1990 levels.

Notable results of the carbon neutrality scenario (version of September 2021) include the following:

- There is an increase in electricity production of almost six times compared with the current level (611 billion kWh by 2060).
- In 2060, solar energy accounts for up to 46% of electricity generation and wind energy for up to 33%, and the use of renewable energy will be accompanied by energy storage systems.
- Electricity increasingly dominates final energy consumption and covers 72% of all energy demand in transport in 2060.
- By 2040, all decentralised heating in buildings is electrified, half of district heating is electrified, and coal-fired heating is phased out entirely.
- The last coal-fired power plant is decommissioned by 2050, and the buildings sector is nearly carbon-neutral.

As of May 2022, the Draft Doctrine (Strategy) was undergoing a revision and approval process. A new body under the Ministry of National Economy was created in 2021 to guide this process: The "Project office for the transition to carbon neutrality and the organisation of the process of finalising the Strategy for achieving carbon neutrality of the Republic of Kazakhstan until 2060". The working body of the project office includes representatives from the Ministry of National Economy, the Institute for Economic Research JSC, the Environmental, Social and Governance (ESG) National Union for Sustainable Development, and the Astana International Financial Centre Green Finance Centre.

Climate change adaptation

According to the Seventh National Communication and Third Biennial Report (MEGNR, 2017), the average annual temperature in Kazakhstan has increased by 0.28°C each decade since 1940, a rate that is faster than the global average. At the same time, annual precipitation has fallen by 0.2 millimetres (mm) each decade. The average annual temperature in the country is expected to increase by 2.4-3.1°C by 2050, and by 3.2-6.0°C by 2100, compared with the average for the period 1980-1999. There is already a statistically significant increase in the number of days with temperatures above 35°C in several parts of the country.

The new Environmental Code includes a new section (Chapter 22) on climate change adaptation. This establishes priority areas, processes of adaptation and responsibilities of various state organisations. Priority areas include agriculture, water management, forestry, and civil protection. A project proposal to help develop a National Adaptation Plan is being developed for financing by the Green Climate Fund jointly with the UNDP in Kazakhstan.

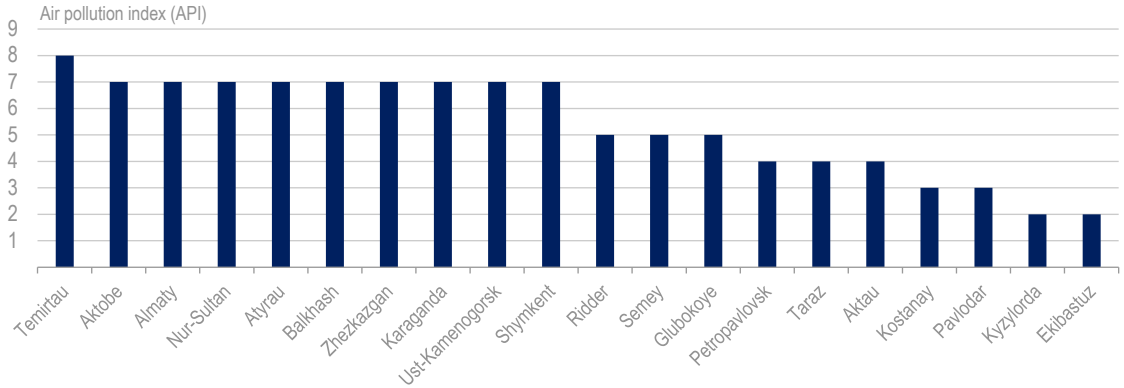
Although it is not listed as a priority sector for adaptation in the new Environmental Code, Kazakhstan's energy sector could be affected by climate change in several ways. For example, climate change increases the risk of higher accident rates at industrial facilities (e.g. non-scheduled shutdowns), especially those that rely on water from surface sources for equipment cooling and other processes, while hydropower operations are particularly sensitive to changes in rainfall patterns. Moreover, the increasing frequency and intensity of extreme weather events, such as heatwaves, wildfires and floods, could lead to more large-scale power outages (IEA, 2020).

Local air pollution

In 2021, Kazakhstan was ranked the 23rd most polluted country in the world, based on $PM_{2.5}$ concentrations (IQAir, 2022). During the winter, several Kazakh cities regularly appear on the list of the world's most polluted cities, with daily $PM_{2.5}$ concentration levels between 100 microgrammes per cubic metre (µg/m^3) and 200 µg/m^3 (see https://www.airkaz.org/). The World Bank (2022b) estimated that ambient air pollution in Kazakhstan causes more than 10 000 premature deaths and costs the economy USD 10.5 billion annually. Most air quality-related diseases and premature deaths were linked to air pollution in the wintertime and to $PM_{2.5}$ levels in particular.

Republican state enterprise (RSE) Kazhydromet is the legally responsible body for environmental monitoring. Data on air quality is reported by the NBS in its Statistical Publication, "Environmental Protection in the Republic of Kazakhstan 2016-2020". According to the air pollution index (API), half of the 20 cities in the country that are included in the index had "high" air pollution levels in 2020 (API[19]>=7) (NBS, 2021).

Figure 7.15 Air pollution index in selected cities of Kazakhstan, 2020

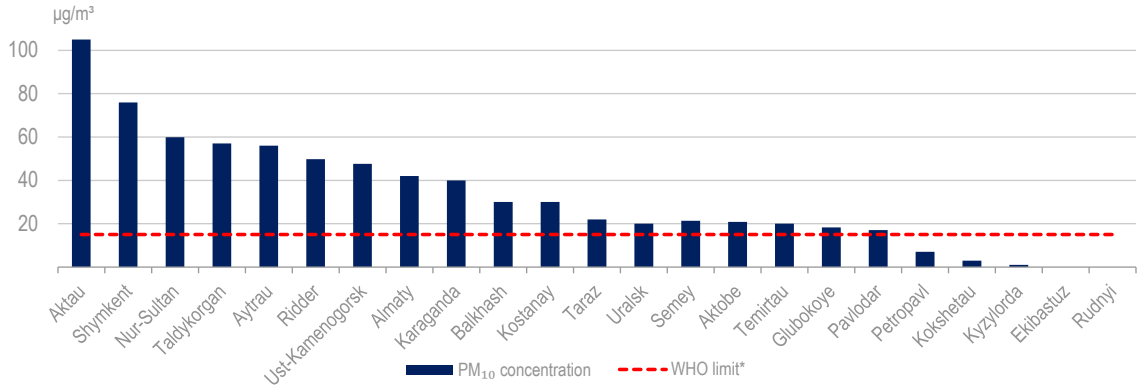


Source: BNS (2021), *Environmental protection in the Republic of Kazakhstan 2016-2020*, Statistical Publication, https://stat.gov.kz/edition/publication/collection.

Methods for estimating and assessing air quality in Kazakhstan differ somewhat from international standards such as those of WHO, relying to some extent on outdated methods (UNECE, 2019). Figure 7.16 provides a comparison of PM_{10} concentration levels for several cities in Kazakhstan against the WHO annual limit value.

[19] API is calculated using average values of concentrations of five substances with the highest maximum allowable concentration (MAC) values divided by the MAC and compared with the harmful concentration levels of SO_2.

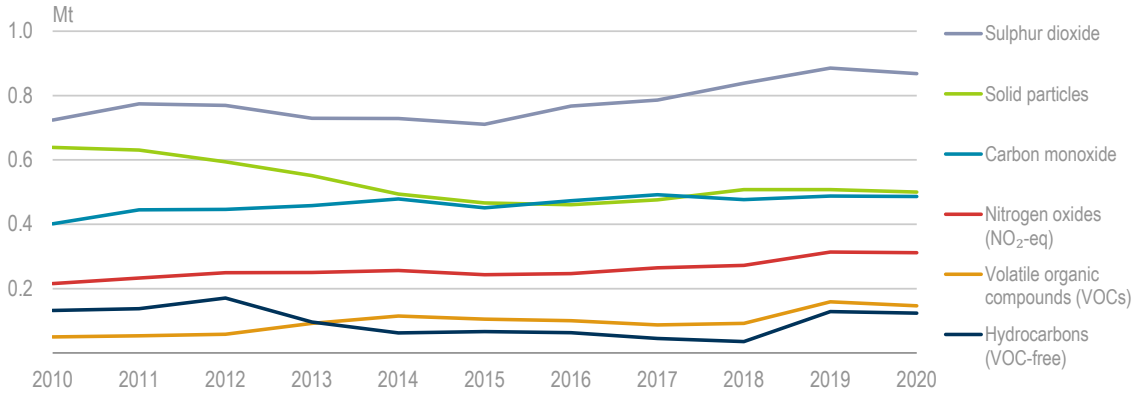
Figure 7.16 Average annual concentration of PM_{10} in selected cities of Kazakhstan, 2020



*The WHO air quality guideline recommends limiting PM_{10} to 15 µg/m³.
Source: BNS (2021), *Environmental protection in the Republic of Kazakhstan 2016-2020*, Statistical Publication, https://stat.gov.kz/edition/publication/collection.

Total emissions of air pollutants from stationary sources in Kazakhstan increased by 13% between 2010 and 2020, from 2.1 Mt to 2.4 Mt. All pollutants from stationary sources, except for solid particles and hydrocarbons, had a rising trend.

Figure 7.17 Emissions of the most common air pollutants from stationary sources



Source: BNS (2021), *Environmental protection in the Republic of Kazakhstan 2016-2020*, Statistical Publication, https://stat.gov.kz/edition/publication/collection.

Sources of air pollution vary from city to city. In industrial cities such as Aktobe, Balkhash, Zhezkazgan, Karaganda, Temirtau and Ust-Kamenogorsk, heavy industries dominate the pollution profile, while Kazakhstan's coal-fired thermal power plants contribute substantially to local air pollution and GHG emissions in areas where they are located.

Table 7.2 Sources of emissions in the cities

City	Industries affecting air pollution
Aktau	Chemical industry
Aktobe	Ferrous metallurgy, chemical
Almaty	Energy, transport
Nur-Sultan	Energy, transport
Atyrau	Oil refining
Balkhash	Non-ferrous metallurgy, energy

City	Industries affecting air pollution
Zhezkazgan	Non-ferrous metallurgy, energy
Karaganda	Energy, coal mining, transport
Kostanay	Energy
Ridder	Non-ferrous metallurgy, energy
Pavlodar	Oil refining, energy
Petropavlovsk	Energy, instrument manufacture
Semey	Energy, construction materials
Taraz	Chemical industry
Temirtau	Ferrous metallurgy, chemical
Uralsk	Energy
Ust-Kamenogorsk	Non-ferrous metallurgy, energy
Shymkent	Non-ferrous metallurgy, chemical, oil refining
Ekibastuz	Energy, coal mining

Source: BNS (2021), *Environmental protection in the Republic of Kazakhstan 2016-2020*, Statistical Publication, https://stat.gov.kz/edition/publication/collection.

Table 7.3 Comparison of air quality standards of Kazakhstan with WHO standard

	WHO standard		Kazakhstan standard	
Pollutant *values expressed in µg/m³)*	Annual	24-hour mean	24-hour mean	Maximum one-time
Fine particulate matter ($PM_{2.5}$)	5	15	35	160
Coarse particulate matter (PM_{10})	15	45	60	300
Nitrogen dioxide (NO_2)	10	25	40	200
Sulphur dioxide (SO_2)	-	40	50	500

Sources: Hygienic Standard for Atmospheric Air in Urban and Rural Settlements (2015); WHO (2021).

A recent study shows that many enterprises have been able to increase their permitted emission limit values (ELVs) in recent years, due to several loopholes in the secondary legislation (Assanov, Zapasnyi and Kerimray, 2021). The methods for determining ELVs are linked to weak environmental quality standards, accompanied by a low level of monitoring and enforcement. With the New Environmental Code, enterprises in Category I will have to obtain an IEP and employ BAT. However, some loopholes may still remain even with the new Environmental Code, such as weak air quality standards (not yet revised), or BAT with less stringent emissions standards and lower-level monitoring and enforcement.

Assessment

The CO_2 intensity of Kazakhstan's GDP is nearly 70% higher than the world average, reflecting the structure of its economy, including energy-intensive heavy industries and reliance on coal in electricity generation. Under the Paris Agreement, Kazakhstan's NDC goal is to reduce GHG emissions 15% below 1990 levels by 2030. In 2020, Kazakhstan's emissions (including LULUCF) stood at 351.2 $MtCO_2$-eq., 8.3% over the 2030 target level. Projections of GHG emissions presented in Kazakhstan's Fourth Biennial Report to the UNFCCC demonstrated that even with additional measures, the NDC target will not be achieved. Attainment of the 2030 NDC target is complicated by the country's large park of ageing coal-fired co-generation plants and growing energy consumption in the residential, transport, commercial and public-services sectors.

During 2000-2020, GHG emissions from fuel combustion nearly doubled. However, fugitive emissions fell by half over the same period. The latest NIR (MEGNR, 2022) showed considerable decline in GHG emissions in 2019 and in 2020, though this may have been due at least in part to the Covid-19 pandemic.

In selected countries/regions (including China, the OECD average, and the world average), the carbon intensity of power generation declined during 2000-2019. In contrast, it rose by 2% in Kazakhstan. Such an increase is attributed to higher level of electricity production and increased coal consumption for heat and power generation, despite some progress in substituting gas for coal and the development of RES.

President Tokayev's pledge to achieve carbon neutrality by 2060 gave a significant boost to the development of climate policies in the country. The Draft Doctrine (Strategy) of Achieving Carbon Neutrality of Kazakhstan until 2060 is currently undergoing a revision and discussion process. A revised NDC and an implementation roadmap for it have also recently been developed, though not yet approved. Major debates are taking place about the costs of decarbonisation and the impacts of increased energy costs on industries and on quality of life. Future studies will need to consider ways to minimise the unintended negative consequences of the energy transition, including impacts on coal-mining regions, industrialised zones and poor households. They should also quantify externalities of the existing energy system on the quality of life (air pollution), negative climate impacts on agriculture and water resources, and risks to industries related to the Carbon Border Adjustment Mechanism (CBAM).

Kazakhstan has made considerable progress improving its Environmental Code. The new code entered in force in July 2021 and includes policies to promote the implementation of BAT. In the first stage, the target is the top 50 polluters, which according to the MEGNR account for 80% of all emissions in the country (Kazistaev, 2021). The New Code also envisages policies for climate change mitigation and adaptation. Article 283 of the Environmental Code defines Kazakhstan's NDC target (-15% from 1990 level by 2030) and requires state bodies to take actions aimed at ensuring the NDC's fulfilment, though the level of enforcement of this is not clear. The new Environmental Code also establishes a "carbon budget", which is intended to be in line with the country's international commitments.

Many cities remain heavily polluted, and there was a rising trend of emissions of air pollutants in the period 2010-2020. Most coal-fired power plants in Kazakhstan do not employ advanced emissions reduction technologies for PM, SO_x and NO_x, while weak air quality standards and loopholes in the environmental permitting system do not provide the right signals for polluters. The new Environmental Code, particularly the Tax Code (in terms of taxes for emissions), continues to provide exemptions and soft conditions for power plants and heating plants, undermining the effectiveness of environmental and climate policies.

Kazenergy (2021) noted that it will be challenging for companies to apply BAT in the current setting of low regulated tariffs without incorporating BAT implementation costs into the tariff-setting rules. Given the influence of powerful industrial associations, it remains uncertain whether the authorities will be able to push stricter regulations for industrial emissions. For example, it was announced that BREFs will not be in line with the EU BREFs but adapted to local conditions.

Kazakhstan is the first FSU country to introduce an ETS. Despite several amendments and fine-tuning processes, the ETS currently is not resulting in changed operational or investment decisions, nor emissions reductions. Generous benchmark levels and numbers of free quotas, especially for coal-fired power plants, mean the number of transactions has been extremely low, as has the average CO_2 price at only USD 1/t CO_2-eq. If the new National Allocation Plan (NAP) for 2022-2025 (not yet published) can reduce the number of free allocated quotas, it may be able to achieve better results in reducing emissions than previous NAPs did. However, benchmarking coefficients in the draft remain the same as those in previous trading periods.

Non-ETS sectors, including transport, the residential sector and services, are increasing their energy consumption and GHG emissions (see Chapter 8 Energy Efficiency), while policies and measures to reduce emissions from these sectors are lacking. The Environmental Code focuses on the large polluters and lacks regulation for small sources. However, the possibility of introducing a carbon tax for non-ETS sectors is mentioned as a possibility in the draft revised NDC.

Recommendations

The government of Kazakhstan should:

- Continue to improve ETS by fine-tuning the quota allocation method and by developing and applying stricter benchmarking coefficients.
- Adopt the NDC implementation roadmap with measures outlined in ETS and non-ETS sectors that collectively aim to achieve the 2030 NDC target.
- Adopt policy measures to reduce emissions from sectors not covered by ETS, including transport, the residential sector and services.
- Intensify efforts to reduce air pollution emissions from coal-fired power plants by gradually adopting more stringent air pollution standards for such plants, including through BAT, and ensuring enforcement. To the extent possible, ensure that Kazakhstan's BAT and technical emissions standards are in line with international best practice.

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8. Energy efficiency

Key data

(2020 provisional)

TFC: 40.3 Mtoe (oil 30.9%, coal 21.6%, district heat 16.3%, natural gas 16.1%, electricity 14.9%, bioenergy 0.1%), +4.0% since 2010

Consumption by sector: residential 33.4%, industry 32.0%, transport 18.5%, services/other 16.1%

TFC per capita: 2.15 toe (world average 2019: 1.30 toe)

Energy intensity (TFC/GDP): 89 toe/USD million PPP (world average 2019: 78 toe/USD) million PPP)

Overview

Kazakhstan has experienced significant GDP growth without a concurrent increase in energy intensity. However, its economy remains highly energy-intensive, with a strong reliance on fossil fuels, including coal, across most sectors. Both residential and transport sector consumption have increased considerably in absolute terms since 2010. A rise in residential demand has been particularly noticeable, with this sector's share of TFC overtaking that of industry in 2020.

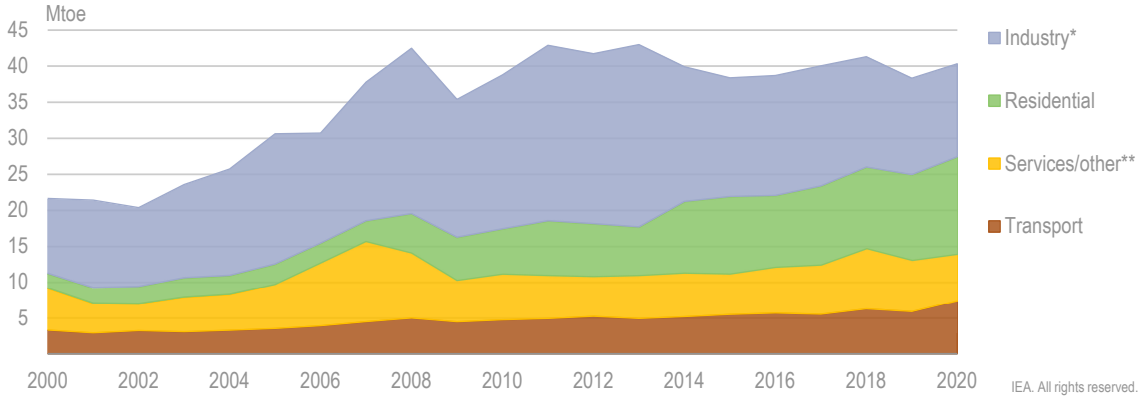
Policies to increase energy efficiency are present across all sectors, and energy efficiency has been identified as a priority by the government. However, efforts to achieve progress on energy efficiency are complicated by low energy tariffs, subsidies, lack of secondary legislation and implementing measures, and the absence of a central co-ordinating body for energy efficiency across governmental departments.

Energy consumption

The assessment of sectoral trends in TFC and other energy consumption metrics is complicated by a lack of historical data as well as data collection methodologies incompatible with international norms. However, efforts to improve data collection and align with international norms have been under way since the mid-2000s, including with the completion of Kazakhstan's first nationwide survey on household fuel and energy consumption in 2018. The BNS did a major revision on the national energy data collection forms in 2021 to obtain data more closely aligned with the International Recommendations for Energy Statistics (UN, 2018). As a result, the accuracy and disaggregation of the sectoral consumption data is expected to increase substantially.

Kazakhstan's TFC amounted to 40.3 Mtoe in 2020, having grown only modestly since 2010 (+4%). The industry sector historically has accounted for the largest share of TFC in Kazakhstan, with strong and consistent demand growth between 2000 and 2012, when industry TFC more than doubled. Between 2012 and 2020, however, this trend was nearly reversed, with industry consumption declining close to 2000 levels by 2020. Over the same period, TFC in the residential sector almost doubled. As a result, the residential sector overtook industry as the largest final consuming sector in 2020 with a 33% share compared with 32% for industry. While growth in consumption has been steady in transport (18% of TFC in 2020) and other sectors (16%), their shares remain relatively low.

Figure 8.1 Total final consumption by sector, 2000-2020



Industry consumption has contracted by 40% since 2010.

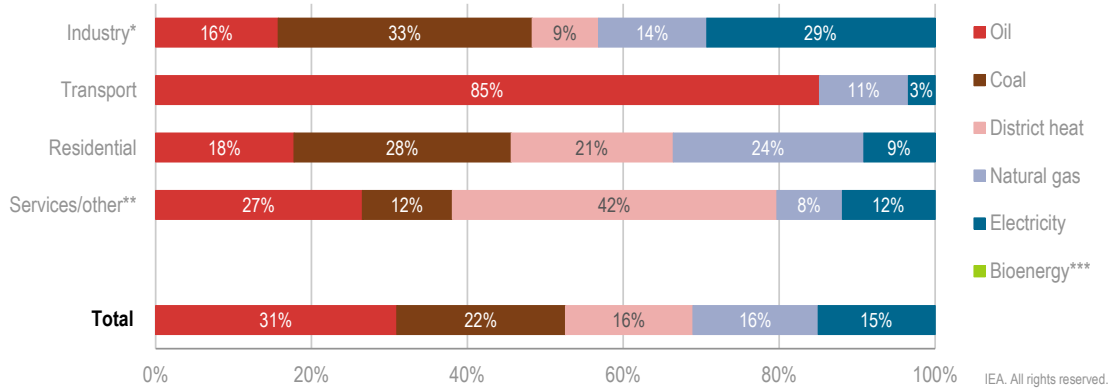
* Includes non-energy consumption.

** Includes commercial and public services, agriculture and forestry.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Fossil fuels accounted for almost 70% of TFC in 2020 (77%). Oil held the largest share (31%) in 2020. Except for the transport sector, where oil is dominant, no single energy source dominates sectoral consumption.

Figure 8.2 Total final consumption by source and sector, 2020



No single energy source dominates sectoral TFC except in the transport sector.

* Includes non-energy consumption.

** Includes commercial and public services, agriculture and forestry.

*** Not visible at this scale.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

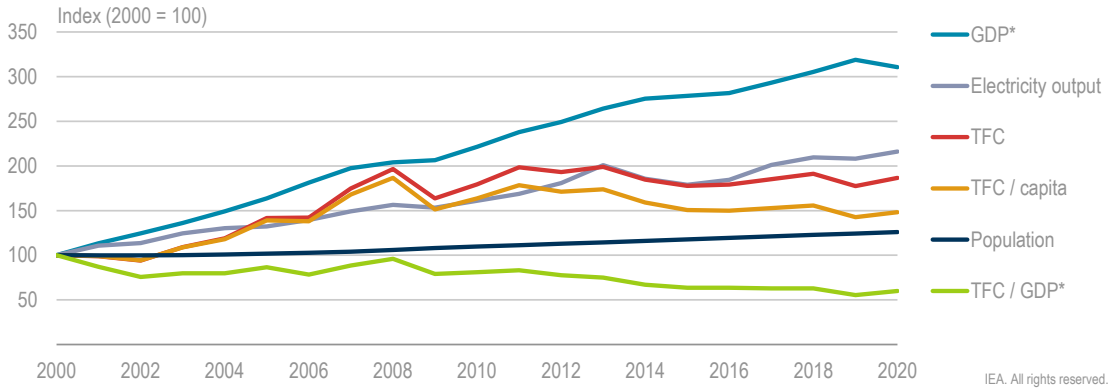
Coal is widely used across nearly all sectors and accounts for 21.6% of TFC. (Coal's share of total energy supply is much higher at 56%, but most of this is converted to electricity in final consumption.) Coal's share in the residential sector (28% of the sectoral total) is among the highest in the world.

District heat, natural gas and electricity held similar shares in the overall TFC in 2020 (15-16%), but the weight of the natural gas is expected to increase in the future, given the nation's gasification plans.

Energy intensity

The energy intensity of Kazakhstan's GDP has decreased steadily in recent decades (-20% during 2000-2020). This is due to GDP growing over threefold during that period, while energy consumption (measured by TFC) nearly doubled in comparison. In practice, however, disaggregated sectoral energy intensity analysis is needed to assess the energy efficiency improvements.

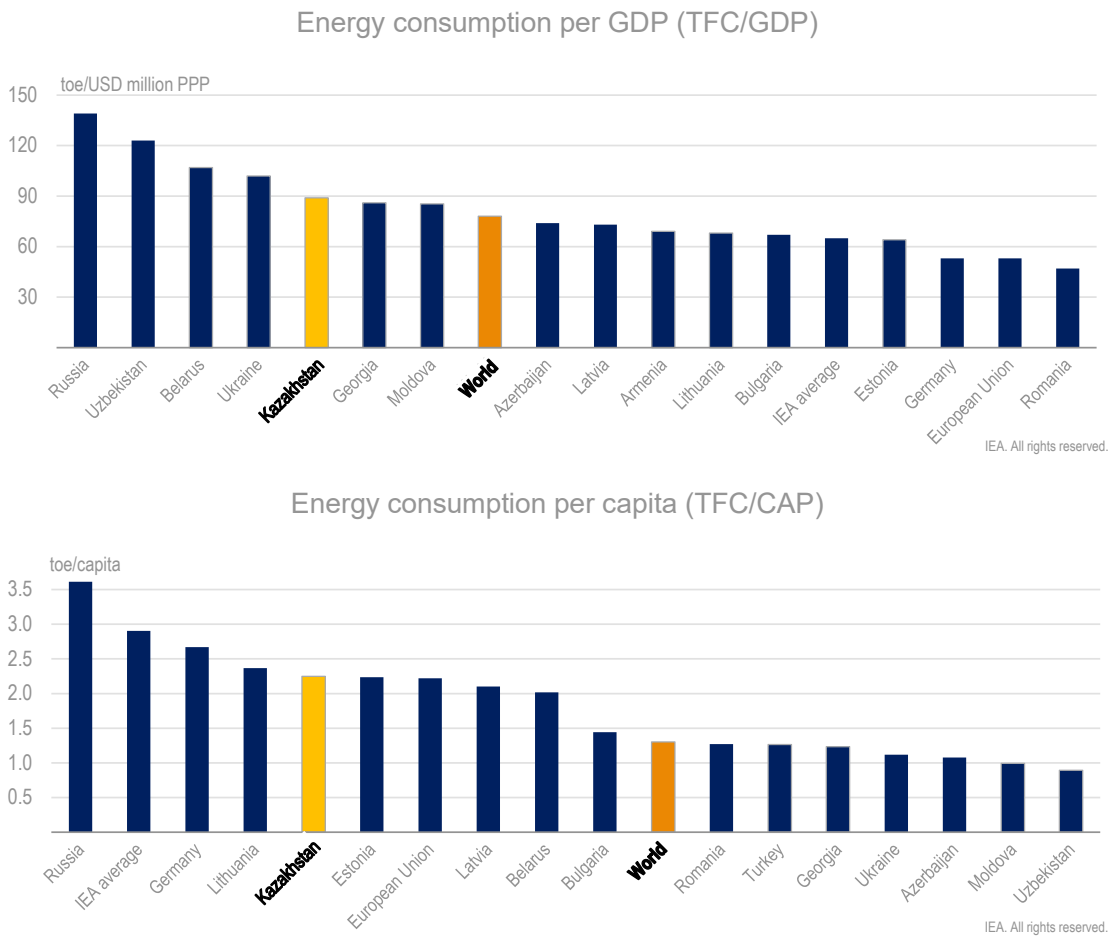
Figure 8.3 Drivers for energy consumption and energy intensity, 2000-2020



TFC nearly doubled during 2000-2020 while GDP more than tripled.

* Expressed in constant 2015 USD billion and PPP.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Figure 8.4 Energy intensity in Kazakhstan and selected countries, 2019



Notes: CAP = capita. TFC does not include the energy transformation sector. GDP is expressed in constant 2015 USD billion at PPP.
Source: IEA (2021), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Sector trends

In the last decade, demand growth appears to have been fastest in the residential sector, which in 2020 surpassed consumption by industry for the first time. In 2020, each of these two sectors was responsible for about one-third of demand. In the same period, overall TFC grew only 4% as industry's consumption reportedly fell by 40%. However, some of this drop may be linked to issues with data collection from Kazakhstan's large industry sector prior to 2014. Similarly, the large apparent increase in consumption by the residential sector is probably due in part to improvements in data collection, although increased access to gas infrastructure also appears to have played a role.

Transport consumption amounted to 18% of TFC in 2020, having grown over 50% since 2010. Services and agriculture together consumed the remaining 16%.

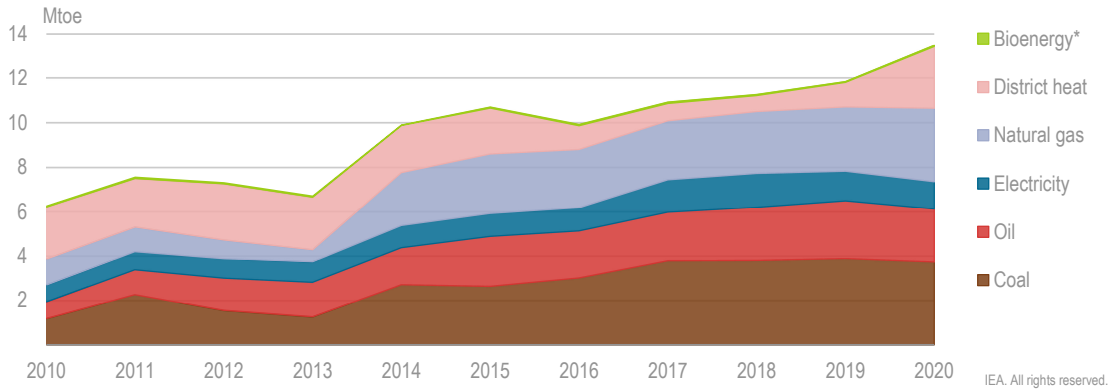
Residential

The residential sector consumed 13.5 Mtoe in 2020, accounting for 33% of TFC. According to available data, energy consumption in the sector has grown by 116% since 2010. It consists mainly of heating (both space and water) which fluctuates annually with outdoor temperatures.

Traditionally, homes have used coal for heating (28% of the sectoral total in 2020), but as a result of gasification, natural gas has quickly become an important energy source for households (24%), particularly in urban areas. Oil (18%) and electricity (9%) are also used, while a large share of urban multiapartment building is connected to district heating systems.

The reported data suggest a strong year-on-year growth in utilisation of district heat between 2019 and 2020, but this may also be linked to limitations of current data collection for district heat. Similarly, bioenergy consumption may be underestimated, although a 2018 household survey indicated only a small share of wood and dung use for home heating, while the widespread availability of cheap coal made it a preferred fuel for residential heating in rural settings. This topic will be reassessed as part of the next household energy consumption survey, which is currently planned for 2023.

Figure 8.5 Total final consumption in the residential sector by source, 2010-2020



Residential coal consumption has increased, though its share has fallen with gasification.

*Includes solid biofuels.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

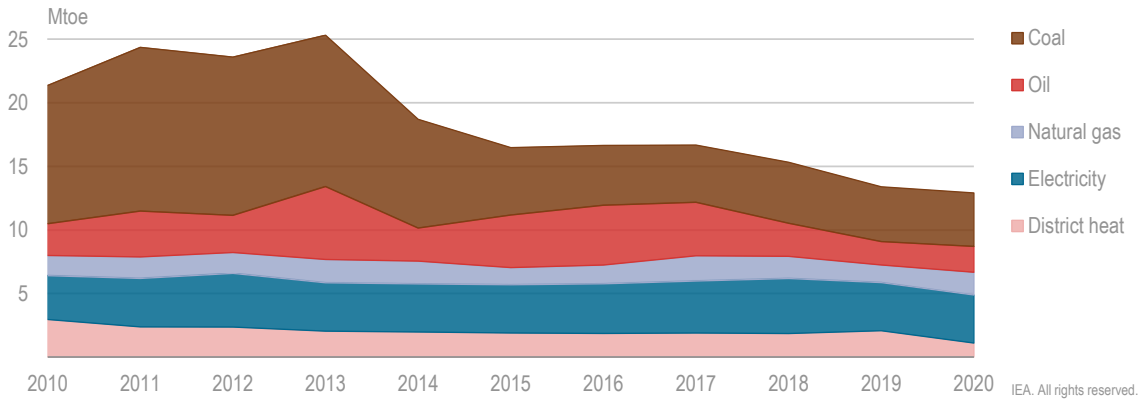
Industry

The industrial sector consumed 12.9 Mtoe in 2020 (32% of TFC). Reported consumption has decreased rapidly, by 40% since 2010. Available subsectoral data show that the decrease has mostly taken place for coal in unspecified industries, though this may be due more to improved reporting in recent years than to an actual reduction in economic activity. In other words, historical coal consumption in industry may be overestimated.

Still, in 2020 coal held the highest share of total consumption by industry (33%). Electricity is the other main energy source for industry (28%), showing a modest demand increase of 10% since 2010. Oil (16%), natural gas (14%) and district (process) heat (9%) covered the rest of sectoral demand in 2020.

Iron and steel and non-ferrous metal manufacturing alone are responsible for over 50% of consumption by industry (55% in 2020). Both subsectors heavily rely on coal and electricity for their energy needs. Outside of manufacturing, 15% of energy is consumed by mining and quarrying, where a range of energy sources are used.

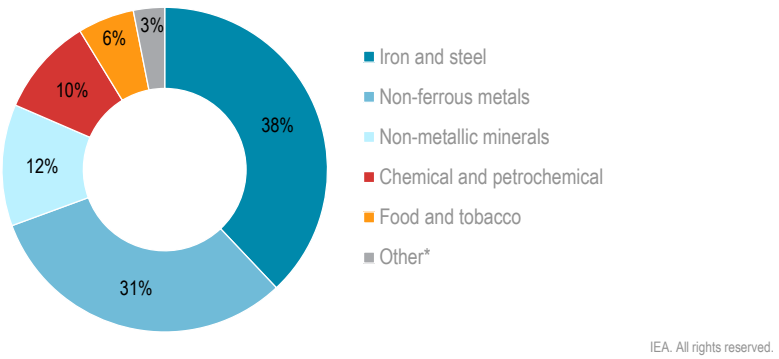
Figure 8.6 Total final consumption in the industrial sector by source, 2010-2020



Coal's apparent decline in industry TFC may be due mainly to improved data collection.

Note: Includes non-energy consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 8.7 Energy consumption in manufacturing activities, 2020



Industrial energy consumption is dominated by the metal subsectors.

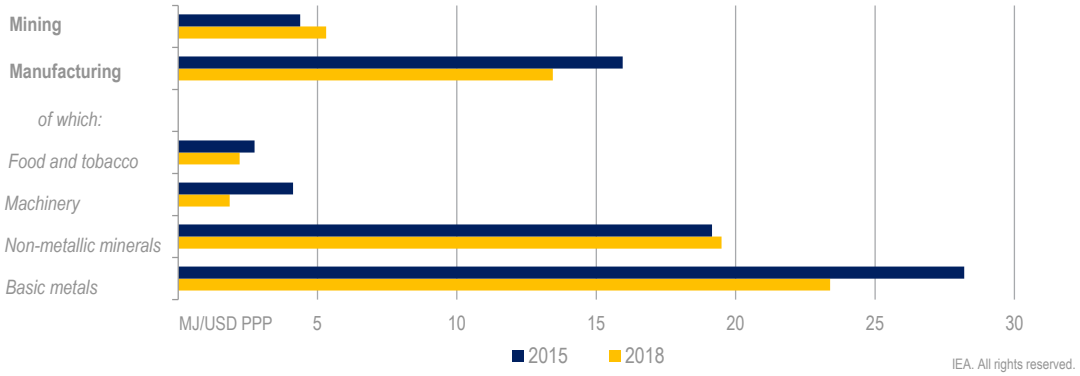
* Includes machinery, paper, pulp and printing, textile and leather, transport equipment, wood and wood products, and unspecified industrial consumption.
Note: Manufacturing corresponds to the Section C of the International Standard Industry Classification (ISIC), it excludes mining, quarrying and construction. It also excludes non-energy uses.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

According to available data, the energy intensity of Kazakhstan's industries appears to be decreasing. Measured as energy consumption per value added, the total energy intensity of manufacturing activities declined by 16% between 2015 and 2018. In other words, such activities have added more value per unit of energy consumed in 2018 than they did in 2015.

Due to gaps in the available data, however, it is unclear whether this reduction stemmed from energy efficiency improvements or from structural changes to the economy (which could have been due to economic disruptions). The intensity development also varies for different industry sectors. For example, in the basic metal industries, which constitute the highest share of energy consumption in industry (over 50%), energy intensity seems to

have decreased by 17% in the period between 2015 and 2018. In contrast, the intensity has slightly increased for non-metallic minerals.

Figure 8.8 Selected intensities in the industrial sector



Recent declines in industrial energy intensity may be due in part to improvements in energy efficiency, but further research is needed to establish link.

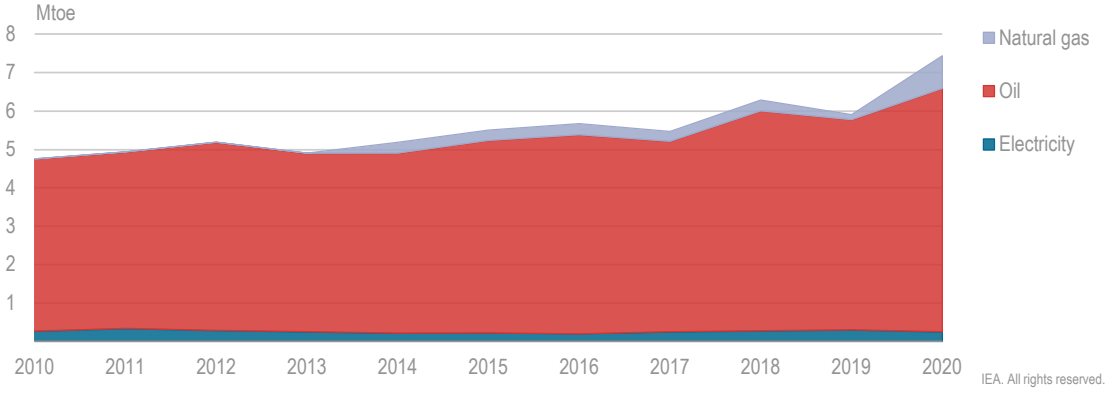
Notes: MJ = megajoule. The manufacturing industry excludes mining, quarrying and construction. It also excludes non-energy uses.
Source: IEA (2021), *Energy Efficiency Indicators* (database), https://www.iea.org/data-and-statistics.

Since there are limited data to validate this analysis, the apparent decrease in energy intensity in industry should merit further investigation by Kazakh policy makers.

Transport

Consumption by the transport sector has grown 57% since 2010. In 2020, it consumed 7.4 Mtoe, accounting for 18% of Kazakhstan's TFC. Oil-based fuels covered 85% of energy demand in the transport sector in 2020 (motor gasoline 65%, diesel 19%). LPG has been used in the transport sector since 2013, though only in the western regions of Kazakhstan, where increases in LPG prices led to civil unrest in January 2022. In 2020, LPG represented 11% of TFC in the transport sector. Consumption of electricity (mostly in rail) has remained stable, but its share shrank to 3% in 2020.

Figure 8.9 Total final consumption in the transport sector by source, 2010-2020



Oil dominates consumption in the transport sector, though the role of natural gas is increasing.

Note: Transport sector demand excludes international aviation and navigation.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Services/other

The remaining TFC consists of services (10% of TFC in 2020), agriculture (2%) and unspecified energy consumption (4%). Given the low shares of these sectors in TFC, the data uncertainties amplify any relative statistical errors, limiting the ability to analyse sectoral consumption.

Policies and measures

With the highest GDP of any country in Central Asia and high levels of energy intensity compared with global averages, Kazakhstan has significant potential to improve energy efficiency. The government has recognised this issue as a priority, and since the early 2000s has put in place a number of energy efficiency policies and measures. These include MEPS for appliances and energy-using equipment and for buildings. Fuel economy standards are in place for the transport sector, and audit provisions exist for industry. However, there are issues with implementation and enforcement across all sectors, and policy frameworks in some sectors lack comprehensiveness.

In the buildings sector, for example, MEPS for new buildings and retrofits reportedly are poorly enforced, and there are no energy efficiency requirements for individual or detached homes (Energy Charter and Kazenergy, 2014; Questionnaire). Progress on MEPS for appliances and equipment relies on support from international donors, with scant evidence of widespread market uptake of more efficient technologies. In the transport sector, tightening of fuel economy standards has been repeatedly delayed, with consumer uptake hampered by a lack of incentives and labelling requirements. While audit requirements are in place for industry, these have been loosened over time, while the implementation of energy-saving measures from audit findings has been limited.

While efforts to stimulate a market for energy efficiency services and energy service companies (ESCOs) have been encouraging, most projects appear to have been largely dependent on support from international donors. A true domestic market for ESCOs remains hampered by restrictive legal provisions and a lack of financial support mechanisms.

There is a consensus among experts that progress towards a more comprehensive framework for energy efficiency in Kazakhstan will require energy tariff reforms. As a result of subsidies, Kazakhstan has one of the world's lowest retail electricity tariffs and one of the highest rates of subsidy per capita, with subsidies accounting for more than 3% of Kazakhstan's GDP. Except for diesel fuel notably for agricultural purposes, most end-consumer energy subsidies are indirect, meaning oil and natural gas are subsidised leading to low electricity generation costs (OECD, 2014).

Maintaining very low prices for electricity and oil in particular is an important social priority for the government, but creates disincentives for more efficient energy use and inhibits the use of more ambitious policy measures.

Legislative framework

The 2012 Law of the Republic of Kazakhstan on Energy Saving and Energy Efficiency Improvement, as amended in 2019, is the primary legislation governing energy efficiency

in Kazakhstan.[20] Where available, sector-specific provisions from this law are detailed in the corresponding sections below, alongside relevant sectoral legislation.

The government planned to conduct an Energy Efficiency 2020 programme between 2013 and 2020, featuring targets to reduce energy intensity by 40% and to reduce fuel consumption in the transport sector by 30% (Energy Charter and Kazenergy, 2014). However, this programme was suspended in 2016, with little information available on monitoring or results (MoE, 2021).

In 2021, a Strategic Development Plan until 2025, including the Green Economy Concept, was updated from its initial 2013 version. This plan features goals to reduce energy intensity by at least 25% from 2008 levels by 2025, and 50% by 2050. It targets electricity savings of 10% or greater by 2025, with priority on manufacturing sectors (non-ferrous and ferrous metallurgy and the chemical industry), along with a target to decrease energy consumption in the public sector (including housing and communal services) by 15%.

Institutional framework

While overall responsibility for energy rests with the Ministry of Energy, the main body responsible for energy efficiency in Kazakhstan is the Committee for Industrial Development, which is part of the Ministry of Industry and Infrastructure Development.

Since 2015, this committee has been supported by the Institute for Electricity Development and Energy Saving, Kazakhenergoexpertiza, which provides information, analysis and consulting services. Among other activities, the institute has created and maintains a register of domestic manufacturers and suppliers of energy-saving equipment and materials. In parallel, the institute maintains the State Energy Register, which is a database of energy-intensive enterprises, i.e. those consuming 1 500 or more tonnes of standard fuel per year. This register also lists government agencies, quasi-public sector entities and natural monopolies consuming energy resources equivalent to 100 or more tonnes of standard fuel annually. As of mid-2022, the register, which is confidential, contained more than 6 000 entries.[21]

The BNS of the Agency for Strategic Planning and Reforms under the President of the Republic of Kazakhstan (formerly the Committee on Statistics under the Ministry of National Economy) is responsible for all energy data collection. Several other institutions play a supporting role in energy efficiency policy development, including the Ministry of Transport and Communications, the Agency on Regulation of Natural Monopolies, the Construction and Communal Services Committee, the Committee on Energy Inspection and Control, the JSC Institute of Electricity Development and Energy Saving, the Kazakhstan Energy Auditors Association, and the Electric Power Association (IEA, 2020a).

While there is no dedicated agency for energy efficiency in Kazakhstan, the non-governmental Kazakhstan Association of Oil-Gas and Energy Sector Organizations, or Kazenergy, provides insights and information on trends.

[20] An English-language version of the law is available at https://adilet.zan.kz/eng/docs/Z1200000541.
[21] The register can be accessed online at a Russian language website, http://kazee.kz/, where the institute publishes occasional summaries and aggregated analysis from the confidential information in the database.

Buildings

The majority of buildings in Kazakhstan do not meet modern standards for energy efficiency. An estimated 70% of buildings lose up to 30% of the thermal energy they consume, with average energy performance levels only one-third those in northern Europe (Energy Charter and Kazenergy, 2014). The energy savings potential in Kazakhstan's buildings is estimated to be above 50% on average (IEA, 2020b).

Most applicable energy efficiency legislation for buildings is contained in Article 11 of the Law on Energy Savings and Energy Efficiency Improvement. The buildings provisions of this law pertain to general requirements and definitions, including methods and parameters for determining air permeability of windows, for example. Technical standards are contained in secondary legislation, including recently adopted acts that prescribe minimum energy performance levels for new buildings and retrofits. The law also mandates that the energy performance of new buildings be specified in a building passport, and that all new buildings be fitted with energy meters (IEA, 2020a).

Despite these laws being in place for a decade, available evidence suggests that energy efficiency in the design, construction and operation of buildings has not been given high priority, and there are concerns regarding implementation and enforcement. The building passport, for example, is granted at the design stage and not subject to follow-up checks of actual energy consumption. Moreover, local authorities reportedly do not necessarily take the energy performance of the building into consideration when issuing building permits (IEA, 2020a).

Given Kazakhstan's long and cold winters, heating is a key challenge for policy makers and citizens, particularly in rural areas with low levels of economic development. Most rural households depend on natural gas, coal or wood for home heating. In addition to increasing winter GHG emissions, coal use for home heating creates significant health concerns. Efforts to improve access to cleaner and more efficient forms of heating in households in Kazakhstan are being informed by a first-ever household fuel and energy consumption survey, conducted in 2018. Information from the survey has been used to support the development of a detailed roadmap for clean household energy use by the IEA (IEA, 2020b).

Heating, which represents around 60% of household energy use in Kazakhstan (IEA, 2020b), is also a challenge in urban settings and notably in apartment buildings connected to ageing and inefficient district heating networks. Most of these systems were constructed during the Soviet era, are not metered and require significant upgrades, while subsidised tariffs for heat limit available funds for modernisation (Energy Charter and Kazenergy, 2014).

A draft law on heating has been developed but has not yet been adopted. The adoption of this law would assist in the delivery of commercial heating (and lighting) upgrades, which USAID ranked as the most cost-effective form of energy-saving measures in a 2017 study of Kazakh energy efficiency opportunities that identified energy savings potentials of nearly 30 000 GWh (USAID, 2017). A summary of the main opportunities identified by USAID, which include also industrial initiatives, are summarised in Box 8.1.

Despite delays on the legislative front, the Kazakhstan Centre for Modernisation and Development of Housing and Communal Service has made some progress on the modernisation of heating systems through installation of metering. Nearly 10 000 heat

meters at the level of buildings across 26 cities have been financed through the centre, which aims to achieve 100% metering by 2025.

Appliances and energy-using equipment

Article 12 of the Law on Energy Savings and Energy Efficiency Improvement includes MEPS and labelling requirements for electricity-consuming devices. Such requirements are informed by the set of common standards developed in the context of the EAEU. Implementation is aided by an ongoing joint project between Kazakhstan and UNDP (UNDP, 2017). Experts cite issues around implementation and enforcement of these rules, while low tariffs provide a disincentive to invest in more efficient equipment.

In the area of lighting, the sale and use of incandescent lamps of 25 watts and above has been prohibited since the beginning of 2014, including in public procurement. However, enforcement reportedly has not been rigorous (Kazenergy, 2019). There are no active measures to promote the use of more efficient lighting in Kazakhstan (IEA, 2020a).

Transport

In 2015, the government issued requirements for energy efficiency in the transport sector, including Euro-4 emissions standards and restrictions on imports of older vehicles. However, there have been issues with the monitoring and enforcement of these provisions. There is also a lack of testing and inspection regimes and of stimulus measures to promote adoption (IEA, 2020a).

Additional policies in the transport sector include standards for electricity consumption for electric trains, as well as new public procurement rules that require vehicles purchased by public entities from 2022 to meet fuel consumption standards. Improvements to traffic control systems have also been proposed as part of the Green Kazakhstan Project, though little evidence is available to date on the success of these measures. Efforts to promote more efficient vehicle purchasing in public procurement have been introduced recently within the framework of a Road Project on Energy Conservation and Energy Efficiency, covering the period 2022-2026 (MoE, 2021).

Industry

According to the 2012 Law on Energy Saving and Energy Efficiency Improvement, enterprises included in the State Energy Register (i.e. those consuming more than 1 500 t of coal-equivalent units of energy per year) are required to undertake an energy audit every five years, and enterprises are required to satisfy energy intensity benchmarks set by the government. The Kazakhstan Centre for Industry and Export, Kazindustry, also has a programme to reimburse part of the costs of audits and the implementation of efficiency measures. In addition, since 2015, energy efficiency requirements for industrial process and equipment have been in place.

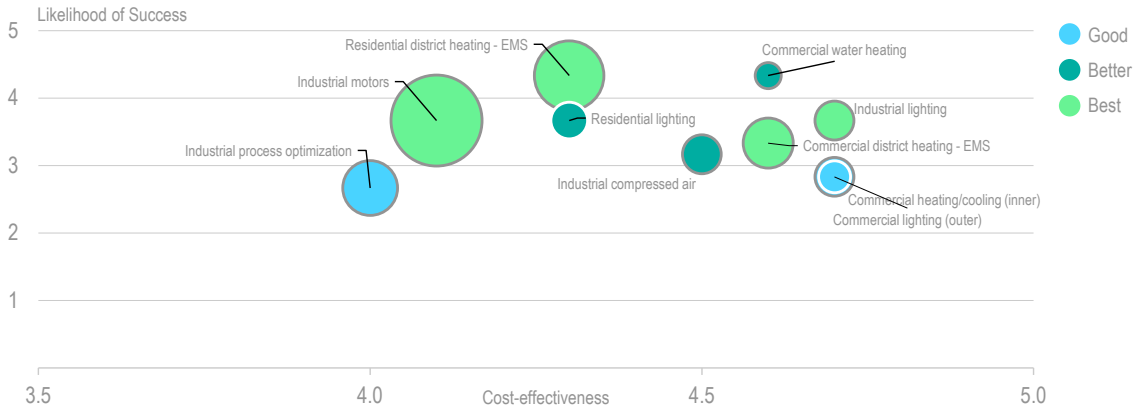
However, it is not clear to what extent measures are enforced, including how or whether companies are required to address the results of audits. Requirements to draw up energy management plans based on such audits were dropped from legislation in 2015 (Kazenergy, 2019). Similarly, requirements for enterprises to introduce energy management protocols such as ISO 50001 were previously part of the 2012 law, but subsequently removed. Companies are now encouraged to introduce energy management protocols on a voluntary basis. To date, less than 1% of enterprises in Kazakhstan have adopted an energy management protocol (MoE, 2021).

Box 8.1 USAID study on energy efficiency opportunities in Kazakhstan

A 2017 study by USAID identified residential district heating energy management systems, industrial motors, industrial lighting and commercial district heating energy management systems as the "best" opportunities for energy efficiency interventions in Kazakhstan.

The study, which graded opportunities according to feasibility (likelihood of success), cost-effectiveness and size (in terms of savings potentials) also identified "better" and "good" opportunities based on these criteria. These additional opportunities, as shown in Figure 8.10, include residential and commercial water heating, among others.

Figure 8.10 Top ten energy efficiency opportunities for Kazakhstan identified by USAID



The diameter of bubbles represents opportunity size expressed in the study in terms of GWh and GHG savings. Cost-effectiveness and likelihood scores were developed as part of the study and take into consideration factors such as regulatory framework and market readiness.

Note: EMS = energy management system.
Source: USAID (2017), *Identifying and Prioritizing Energy Efficiency Opportunities in Kazakhstan*, https://pdf.usaid.gov/pdf_docs/PA00SX8V.pdf.

Financing, international collaboration and energy services

Multilateral organisations play an important role in financing and promoting energy efficiency efforts in Kazakhstan. UNDP, in partnership with the Ministry of Industry and Infrastructure Development, has created a lending facility for small and medium-sized enterprises (SMEs) to help them finance the introduction of green technologies. This mechanism has supported at least 100 projects so far, including ones to improve efficiency in residential and public buildings, introduce light-emitting diode (LED) lighting, and modernise boiler houses (UNDP, 2021).

In addition, more than 130 energy efficiency projects, notably including ESCO projects for industrial facilities and public or commercial buildings, have been conducted as part of the World Bank-funded Kazakhstan Energy Efficiency Project (KEEP) (World Bank, 2022).

The EBRD announced a microfinance facility in 2020 to support SMEs and households to procure energy efficiency and renewable energy technologies as part of a

USD 30 million Green Economy Financing Facility to support "gender inclusive green finance for households and small private sector companies investing in green technology solutions" (EBRD, 2020).

The government has also been active in promoting ESCOs as part of its national plan, "100 concrete steps to implement five institutional reforms," which includes dedicated provisions for ESCOs (MoE, 2021). As part of this, Kazakhstan's Institute for Electricity Development and Energy Saving has responsibility for the development and maintenance of a Kazakh Energy Efficiency Map, which provides information on a variety of projects, including 45 projects through ESCO and public-private partnership mechanisms, being implemented across the country.

There are some discrepancies in available information regarding the actual number of ESCO projects currently in operation in Kazakhstan, though it appears that enterprises concluded fewer than ten energy-saving contracts with ESCOs between 2015 and 2018. In addition, and despite the initiatives cited above, legal restrictions, subsidised energy tariffs and a lack of positive incentives remain significant barriers for the development of energy services activities and the ESCO market in Kazakhstan (IEA, 2020a).

Assessment

Kazakhstan's energy intensity levels are among the highest in the world, with significant opportunity for energy efficiency improvements, notably in the buildings sector.

Residential subsector consumption has increased significantly since 2012, according to available data, with heating accounting for 60% of household energy demand. Analysis of sectoral consumption trends is complicated by historical data inconsistencies, although improvements have been made through modernisation efforts since 2016, notably through the completion of a household survey on fuel and energy consumption.

An overarching legal framework for energy efficiency has been in place in Kazakhstan since 2012 with the Law on Energy Savings and Energy Conservation, along with overarching strategies and programmes in support of Kazakhstan's clean energy transition and GHG reduction efforts. While relatively comprehensive, the development, implementation and enforcement of energy efficiency legislation, as well as secondary legislation and standards, across sectors has been incomplete. Moreover, there is no dedicated energy efficiency agency in Kazakhstan, with authority for efficiency instead spread across multiple committees and departments within ministries.

Very low energy tariffs, based on indirect subsidies, create barriers to investment and effective policy design and implementation across all sectors. With among the world's highest rates of subsidies, end consumers are not aware of the full cost of energy and have few incentives to reduce their consumption through the purchase of more energy-efficient equipment, for example.

In the buildings sector, existing measures do not equate to a comprehensive set of codes covering new construction and major retrofits, so that key building segments such as detached homes are not covered. Important provisions for new buildings and retrofits, notably energy passports, are not being effectively enforced by local authorities.

Heating sector challenges remain in rural settings, where a reliance on coal creates climate and health concerns, and in urban settings, where outdated district heating systems and a lack of metering reduce efficiency performance.

The potential to increase the efficiency of appliances and energy-using equipment remains largely untapped in Kazakhstan, though efforts are under way with support from international partners to improve existing MEPS frameworks.

In transport, vehicle fuel economy standards and import bans on older vehicles are not effectively enforced, and robust testing regimes are lacking.

In the industry sector, existing energy performance requirements as well as energy audit requirements are poorly enforced, with energy efficiency potentials in industry remaining largely untapped.

An encouraging number of energy efficiency projects have been realised across sectors in Kazakhstan with support from international partners. However, restrictive legal provisions and subsidised energy tariffs continue to create barriers for the development of a market for energy services and ESCOs.

Recommendations

The government of Kazakhstan should:

- Gradually phase out energy subsidies that create disincentives to investments in energy efficiency while mitigating the impact of price increases on vulnerable segments of the population.
- Develop a comprehensive set of building codes for new construction and major retrofits across all major building classes in line with achievable norms, accompanied by effective enforcement and incentives.
- Develop a national strategy to improve access to affordable and efficient heating in both rural and urban areas.
- Ensure the enforcement of existing vehicle fuel economy standards and import bans on older passenger vehicles, supported by testing regimes and incentive mechanisms.
- Remove legal restrictions that act as barriers to the development of energy services and ESCOs.

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ANNEX A: Organisations visited

Review criteria

The Shared Goals, which were adopted by the International Energy Agency (IEA) Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

Preparation of the report

This report is based on the information provided in the IEA IDR Questionnaire filled by the government of Kazakhstan and on information about the energy sector and policies of Kazakhstan that is publicly available.

Philip Swanson drafted most of the report and Armin Mayer drafted Chapter 8. Aiymgul Kerimray wrote Chapter 7. Markus Fager-Pintilä prepared the graphs and drafted the sections related to statistics and energy data. Anna Petrus organised and co-ordinated the process.

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ANNEX B: Energy balances and key statistical data

Kazakhstan

Energy balances and key statistical data

Unit: Mtoe

SUPPLY		1990	2000	2010	2017	2018	2019	2020
TOTAL PRODUCTION		**90.98**	**78.58**	**156.88**	**165.58**	**174.10**	**166.94**	**159.03**
Coal		58.01	34.13	48.55	45.93	47.21	44.92	44.31
Peat		-	-	-	-	-	-	-
Oil		26.45	36.10	82.99	87.32	92.18	92.17	87.30
Natural gas		5.77	7.62	24.61	31.28	33.69	28.80	26.32
Biofuels and waste[1]		0.11	0.07	0.05	0.04	0.05	0.06	0.05
Nuclear		-	-	-	-	-	-	-
Hydro		0.63	0.65	0.69	0.96	0.89	0.86	0.83
Wind		-	-	-	0.03	0.04	0.06	0.09
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	0.01	0.03	0.07	0.13
TOTAL NET IMPORTS		**-17.52**	**-42.93**	**-85.64**	**-101.55**	**-100.33**	**-93.97**	**-92.91**
Coal	Exports	22.85	15.29	13.77	12.68	11.72	11.04	12.72
	Imports	4.79	0.68	0.59	0.61	0.84	0.88	0.85
	Net imports	-18.06	-14.61	-13.18	-12.07	-10.88	-10.17	-11.87
Oil	Exports	21.71	31.37	77.78	73.76	75.51	75.07	75.18
	Imports	16.74	3.70	7.70	2.12	1.68	0.60	1.02
	Int'l marine and aviation bunkers	-0.90	-0.08	-0.21	-0.51	-0.64	-0.65	-0.33
	Net imports	-5.88	-27.75	-70.28	-72.15	-74.47	-75.12	-74.49
Natural gas	Exports	3.18	4.37	5.23	22.54	23.04	22.57	17.48
	Imports	8.10	3.54	2.95	5.52	8.34	13.91	10.98
	Net imports	4.92	-0.83	-2.28	-17.02	-14.70	-8.66	-6.50
Electricity	Exports	1.21	0.01	0.15	0.49	0.43	0.21	0.20
	Imports	2.70	0.27	0.25	0.11	0.13	0.17	0.13
	Net imports	1.49	0.26	0.10	-0.38	-0.30	-0.04	-0.06
TOTAL STOCK CHANGES		**-**	**0.03**	**-2.11**	**1.09**	**0.40**	**0.11**	**-0.44**
TOTAL SUPPLY (TES)[3]		**73.45**	**35.68**	**69.13**	**65.11**	**74.17**	**73.08**	**65.67**
Coal		39.95	19.76	34.51	35.01	36.41	34.47	32.61
Peat		-	-	-	-	-	-	-
Oil		20.58	8.36	11.46	15.37	18.40	17.46	11.84
Natural gas		10.68	6.57	22.32	14.00	18.62	20.12	20.17
Biofuels and waste[1]		0.11	0.07	0.05	0.11	0.08	0.08	0.06
Nuclear		-	-	-	-	-	-	-
Hydro		0.63	0.65	0.69	0.96	0.89	0.86	0.83
Wind		-	-	-	0.03	0.04	0.06	0.09
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	0.01	0.03	0.07	0.13
Electricity trade[4]		1.49	0.26	0.10	-0.38	-0.30	-0.04	-0.06
Shares in TES (%)								
Coal		*54.4*	*55.4*	*49.9*	*53.8*	*49.1*	*47.2*	*49.7*
Peat		-	-	-	-	-	-	-
Oil		*28.0*	*23.4*	*16.6*	*23.6*	*24.8*	*23.9*	*18.0*
Natural gas		*14.5*	*18.4*	*32.3*	*21.5*	*25.1*	*27.5*	*30.7*
Biofuels and waste[1]		*0.2*	*0.2*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*
Nuclear		-	-	-	-	-	-	-
Hydro		*0.9*	*1.8*	*1.0*	*1.5*	*1.2*	*1.2*	*1.3*
Wind		-	-	-	*0.0*	*0.1*	*0.1*	*0.1*
Geothermal		-	-	-	-	-	-	-
Solar/other[2]		-	-	-	*0.0*	*0.0*	*0.1*	*0.2*
Electricity trade[4]		*2.0*	*0.7*	*0.1*	*-0.6*	*-0.4*	*-0.1*	*-0.1*

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND FINAL CONSUMPTION	1990	2000	2010	2017	2018	2019	2020
TFC	**59.63**	**21.61**	**38.78**	**40.04**	**41.31**	**38.33**	**40.33**
Coal	15.78	3.85	14.98	9.32	9.59	9.02	8.71
Peat	-	-	-	-	-	-	-
Oil	15.08	6.38	9.12	12.58	12.02	10.89	12.47
Natural gas	7.77	2.67	3.32	5.62	5.61	5.05	6.48
Biofuels and waste[1]	0.11	0.07	0.05	0.06	0.05	0.04	0.05
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	8.30	3.03	4.93	6.54	6.91	6.19	6.03
Heat	12.59	5.60	6.38	5.92	7.13	7.14	6.59
Shares in TFC (%)							
Coal	*26.5*	*17.8*	*38.6*	*23.3*	*23.2*	*23.5*	*21.6*
Peat	-	-	-	-	-	-	-
Oil	*25.3*	*29.5*	*23.5*	*31.4*	*29.1*	*28.4*	*30.9*
Natural gas	*13.0*	*12.4*	*8.6*	*14.0*	*13.6*	*13.2*	*16.1*
Biofuels and waste[1]	*0.2*	*0.3*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	*13.9*	*14.0*	*12.7*	*16.3*	*16.7*	*16.1*	*14.9*
Heat	*21.1*	*25.9*	*16.5*	*14.8*	*17.3*	*18.6*	*16.3*
TOTAL INDUSTRY[5]	**28.65**	**10.40**	**21.39**	**16.69**	**15.34**	**13.41**	**12.92**
Coal	15.78	3.85	10.89	4.51	4.80	4.31	4.21
Peat	-	-	-	-	-	-	-
Oil	7.38	2.00	2.50	4.21	2.60	1.84	2.03
Natural gas	-	-	1.59	1.99	1.75	1.39	1.80
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	5.50	1.82	3.45	4.09	4.33	3.79	3.78
Heat	-	2.74	2.96	1.89	1.85	2.07	1.10
Shares in total industry (%)							
Coal	*55.1*	*37.0*	*50.9*	*27.0*	*31.3*	*32.2*	*32.6*
Peat	-	-	-	-	-	-	-
Oil	*25.8*	*19.2*	*11.7*	*25.2*	*17.0*	*13.7*	*15.7*
Natural gas	-	-	*7.4*	*11.9*	*11.4*	*10.4*	*13.9*
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	*19.2*	*17.5*	*16.1*	*24.5*	*28.3*	*28.3*	*29.3*
Heat	-	*26.3*	*13.8*	*11.3*	*12.1*	*15.4*	*8.5*
TRANSPORT	**5.45**	**3.32**	**4.75**	**5.54**	**6.29**	**5.91**	**7.44**
OTHER[6]	**25.53**	**7.89**	**12.65**	**17.81**	**19.68**	**19.01**	**19.97**
Coal	-	0.00	4.09	4.74	4.78	4.69	4.49
Peat	-	-	-	-	-	-	-
Oil	2.81	1.19	2.13	3.41	3.69	3.58	4.11
Natural gas	7.77	2.67	1.73	3.38	3.58	3.54	3.83
Biofuels and waste[1]	0.11	0.07	0.05	0.06	0.05	0.04	0.05
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	2.25	1.07	1.22	2.20	2.30	2.09	2.00
Heat	12.59	2.86	3.43	4.03	5.28	5.07	5.49
Shares in other (%)							
Coal	-	*0.1*	*32.4*	*26.6*	*24.3*	*24.7*	*22.5*
Peat	-	-	-	-	-	-	-
Oil	*11.0*	*15.1*	*16.9*	*19.2*	*18.8*	*18.8*	*20.6*
Natural gas	*30.4*	*33.9*	*13.6*	*19.0*	*18.2*	*18.6*	*19.2*
Biofuels and waste[1]	*0.4*	*0.9*	*0.4*	*0.4*	*0.3*	*0.2*	*0.3*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	*8.8*	*13.6*	*9.6*	*12.3*	*11.7*	*11.0*	*10.0*
Heat	*49.3*	*36.3*	*27.1*	*22.6*	*26.8*	*26.7*	*27.5*

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1990**	**2000**	**2010**	**2017**	**2018**	**2019**	**2020**
ELECTRICITY GENERATION[7]							
Input (Mtoe)	16.96	11.63	11.09	20.56	21.17	21.75	20.60
Output (Mtoe)	7.51	4.41	7.11	8.87	9.25	9.19	9.54
Output (TWh)	87.38	51.32	82.65	103.20	107.60	106.88	110.89
Output Shares (%)							
Coal	*71.1*	*69.5*	*80.7*	*66.8*	*69.5*	*69.0*	*67.3*
Peat	-	-	-	-	-	-	-
Oil	*10.0*	*5.2*	*0.8*	*0.8*	*0.1*	*0.1*	*0.1*
Natural gas	*10.5*	*10.7*	*8.9*	*21.1*	*19.9*	*20.1*	*21.7*
Biofuels and waste[1]	-	-	-	*0.0*	*0.0*	*0.0*	*0.0*
Nuclear	-	-	-	-	-	-	-
Hydro	*8.4*	*14.7*	*9.7*	*10.9*	*9.7*	*9.4*	*8.7*
Wind	-	-	-	*0.3*	*0.4*	*0.7*	*0.9*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	*0.2*	*0.4*	*0.8*	*1.3*
TOTAL LOSSES	**14.12**	**15.46**	**34.59**	**23.29**	**23.02**	**22.67**	**21.75**
of which:							
Electricity and heat generation[8]	9.43	7.21	3.98	11.67	11.91	12.55	11.06
Other transformation	1.76	2.49	2.82	2.08	2.27	1.65	1.22
Own use and transmission/distribution losses	2.92	5.76	27.79	9.54	8.84	8.48	9.47
Statistical differences	**0.30**	**1.39**	**4.24**	**-1.78**	**-9.84**	**-12.08**	**-3.59**
INDICATORS	**1990**	**2000**	**2010**	**2017**	**2018**	**2019**	**2020**
GDP (billion 2015 USD)	95.93	66.18	146.56	194.06	202.02	211.11	205.62
Population (millions)	16.35	14.88	16.32	18.04	18.28	18.51	18.75
TES/GDP (toe/1000 USD)[9]	0.77	0.54	0.47	0.34	0.37	0.35	0.32
Energy production/TES	1.24	2.20	2.27	2.54	2.35	2.28	2.42
Per capita TES (toe/capita)	4.49	2.40	4.24	3.61	4.06	3.95	3.50
Oil supply/GDP (toe/1000 USD)[9]	0.21	0.13	0.08	0.08	0.09	0.08	0.06
TFC/GDP (toe/1000 USD)[9]	0.62	0.33	0.26	0.21	0.20	0.18	0.20
Per capita TFC (toe/capita)	3.65	1.45	2.38	2.22	2.26	2.07	2.15
CO_2 emissions from fuel combustion ($MtCO_2$)[10]	237.3	112.0	221.1	206.0	208.7	197.5	204.4
CO_2 emissions from bunkers ($MtCO_2$)[10]	2.7	0.2	0.6	1.5	1.9	1.9	1.0
GROWTH RATES (% per year)	**90-00**	**00-10**	**10-17**	**17-18**	**18-19**	**19-20**	**00-20**
TES	-7.0	6.8	-0.9	13.9	-1.5	-10.1	3.1
Coal	-6.8	5.7	0.2	4.0	-5.3	-5.4	2.5
Peat	-	-	-	-	-	-	-
Oil	-8.6	3.2	4.3	19.7	-5.1	-32.1	1.8
Natural gas	-4.7	13.0	-6.4	33.0	8.0	0.3	5.8
Biofuels and waste[1]	-4.4	-3.7	11.4	-29.8	4.4	-26.3	-1.2
Nuclear	-	-	-	-	-	-	-
Hydro	0.2	0.6	4.9	-7.3	-3.9	-3.3	1.3
Wind	-	-	-	35.5	53.5	45.5	-
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	140.9	116.1	79.4	-
TFC	-9.7	6.0	0.5	3.2	-7.2	5.2	3.2
Electricity consumption	-9.6	5.0	4.1	5.5	-10.4	-2.5	3.5
Energy production	-1.5	7.2	0.8	5.1	-4.1	-4.7	3.6
Net oil imports	16.8	9.7	0.4	3.2	0.9	-0.8	5.1
GDP	-3.6	8.3	4.1	4.1	4.5	-2.6	5.8
TES/GDP	-3.4	-1.3	-4.7	9.4	-5.7	-7.7	-2.6
TFC/GDP	-6.2	-2.1	-3.5	-0.9	-11.2	8.0	-2.5

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Notes

1. Biofuels and waste in Kazakhstan comprise solid biofuels. Data are often based on partial surveys and may not be comparable between countries.
2. Other includes solar photovoltaic.
3. Excludes international marine bunkers and international aviation bunkers.
4. Total supply of electricity represents net trade. A negative number in the share of TES indicates that exports are greater than imports.
5. Industry includes non-energy use.
6. Other includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
7. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
8. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 100% for hydro, wind and solar photovoltaic.
9. Toe per thousand US dollars at 2015 prices and exchange rates.
10. "CO_2 emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach methodology from the 2006 IPCC Guidelines. Emissions from international marine and aviation bunkers are not included in national totals.

ANNEX C: International Energy Agency Shared Goals

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydropower, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 in Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

ANNEX D: Glossary and list of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

API	air pollution index
BAT	best available techniques (official term used by Kazakhstan, akin to best available technology)
BBS	Beyneu-Bozoy-Shymkent (pipeline)
BNS	National Bureau of National Statistics
BREFs	BAT reference books
CAC	Central Asia-Centre
CAEPCO	Central-Asian Electric Power Corporation
CAGP	Central Asia-China Gas Pipeline
CAPS	Central Asia Power System
CCGT	combined-cycle gas turbine
CERN	European Organisation for Nuclear Research
CNG	compressed natural gas
CNODC	China National Oil and Gas Exploration and Development Corporation
CNPC	China National Petroleum Corporation
CO	carbon monoxide
CO_2	carbon dioxide
CPC	Caspian Pipeline Consortium
CSTO	Collective Security Treaty Organization
EAEU	Eurasian Economic Union
EBRD	European Bank for Reconstruction and Development
ELV	emission limit value
ERG	Eurasian Resources Group
ESCO	energy service company
ETS	emissions trading scheme
EU	European Union
FiTs	feed-in tariffs
FEED	front-end engineering design

FSC	Financial Settlement Centre for Renewable Energy Support LLP
FSU	Former Soviet Union
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GMI	Global Methane Initiative
HPP	hydropower plant
IAEA	International Atomic Energy Agency
ICA	Intergas Central Asia
ICGTIP	International Center for Green Technologies and Investment Projects
IEA	International Energy Agency
IEP	Integrated Environmental Permit
IES	integrated electricity systems
INP	Institute of Nuclear Physics
IRENA	International Renewable Energy Agency
ISIC	International Standard Industry Classification
JODI	Joint Organisations Data Initiative
JSC	joint-stock company
JV	joint venture
KEEP	Kazakhstan Energy Efficiency Project
KEGOC	Kazakhstan Electricity Grid Operating Company
KMG	KazMunayGas
KOREM	Kazakhstan Electricity and Power Market Operator
KREM	Committee for the Regulation of Natural Monopolies and Protection of Competition
LED	light-emitting diode
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MAC	maximum allowable concentration
MEGNR	Ministry of Ecology, Geology and Natural Resources
MEPS	minimum energy performance standards
NAP	National Allocation Plan
NCOC	North Caspian Operating Company
NDC	Nationally Determined Contribution
NIR	National Inventory Report

NNC	National Nuclear Centre
NO_x	nitrogen oxides
NPP	net primary production
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting States
PM	particulate matter
PPA	power purchase agreement
PPP	purchasing power parity
PV	photovoltaic
RES	renewable energy sources
SAIDI	System Average Interruption Index
SIEC	Standard International Energy Product Classification
SMEs	small and medium-sized enterprises
SO_2	sulphur dioxide
SO_x	sulphur oxides
TCO	Tengizchevroil
TES	total energy supply
TFC	total final energy consumption
TIMES model	The Integrated MARKAL-EFOM System
UGS	underground gas storage
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
USAID	US Agency for International Development
VAT	value-added tax
WCAM	with current and additional measures
WCM	with current measures
WHO	World Health Organization
WOM	without measures

Units of measure

µg/m^3	microgrammes per cubic metre
bbl	barrels
bcm	billion cubic metres
Bt	billion tonnes
GW	gigawatt
GWh	gigawatt-hour
kcal	kilocalorie
kcm	thousand cubic metres
kg	kilogramme
km	kilometre
km^2	square kilometre
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
m	metre
mb	million barrels
mcm	million cubic metre
Mt	million tonnes
$MtCO_2$-eq	million tonnes of carbon dioxide equivalent
Mtoe	million tonnes of oil equivalent
MVA	megavolt-ampere
MW	megawatt
MW_t	megawatt thermal
t	tonne
tC/ha/yr	tonne of carbon per hectare per year
tcm	trillion cubic metres
toe	tonne of oil equivalent
TWh	terawatt-hour

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Kazakhstan 2022

Energy Sector Review

This in-depth review of the energy policies of Kazakhstan follows the same format used by the International Energy Agency (IEA) to review member countries. It was conducted under the auspices of the EU4Energy programme, which is being implemented by the IEA and the European Union, along with the Energy Community Secretariat and the Energy Charter Secretariat.

Kazakhstan has made ambitious commitments to reduce greenhouse gas emissions and increase the role of renewables in its energy supply, but dependence on large reserves of inexpensive domestic coal and a lack of flexible generating capacity make these a challenge. Oil continues to provide much of the country's export earnings and government revenue, while many oil-importing countries have pledged to reduce consumption of fossil fuels, and most oil exports currently transit the Russian Federation. Low domestic energy prices are a social priority for the government, but have made it difficult to promote energy efficiency and stimulate commercial production of gas for the domestic market.

This report assesses the energy sector and related challenges facing Kazakhstan and proposes policy recommendations to improve sector governance, energy efficiency and security of supply.

International Energy Agency

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