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Kazakhstan Energy Profile

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Kazakhstan Energy Profile

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The Republic of Kazakhstan (Kazakhstan) lies in northern Central Asia and is bordered by the Russian Federation (Russia) to the north, China to the east, Kyrgyzstan and Uzbekistan to the south, and the Caspian Sea and Turkmenistan to the west. Kazakhstan's land area is 2 717 300 square kilometres (km^2) with almost 1 894 km of coastline on the Caspian Sea. The capital is Nur-Sultan (previously called Astana) and the country is home to 18.7 million people (www.stat.gov.kz).

Until 2015, Kazakhstan was among the world's top ten fastest-growing economies, mainly owing to development of its rich oil, gas and coal resources and its export-oriented policies. The country is the largest oil producer in Central Asia, with the 12th-highest proven crude oil reserves in the world. Its gross domestic product (GDP) per capita has risen six-fold since 2002 (https://www.worldbank.org/en/country/kazakhstan/overview#3), and in 2019 its real GDP grew 4.5% as a result of higher consumer spending and mining-related investments (https://www.worldbank.org/en/country/kazakhstan/overview#3). Due to the global COVID-19 pandemic, however, Kazakhstan's GDP could contract 3% in 2020 according to World Bank estimates (https://www.worldbank.org/en/country/kazakhstan/overview#3).

Kazakhstan produced 91.9 million tonnes (Mt) of crude oil in 2018 (including gas condensate) with increased production at its Kashagan field (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf). Kashagan, the fifth-largest reserve in the world, is expected to play a major role in Kazakhstan's future oil production, with projected production of 450 thousand barrels per day (kb/d) by 2025 and 955 kb/d by 2040.

Progress has been achieved in Kazakhstan's gas network development: in 2016 three lines of the transnational Turkmenistan-Uzbekistan-Kazakhstan-China gas pipeline were completed, increasing transit gas volumes from 30 billion cubic metres per year (bcm/y) to 55 bcm/y, and the Beineu-Bozoi-Shymkent pipeline connecting the western producing region with the densely populated south also became operational in 2016 (http://energo.gov.kz/index.php?id=49).

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Key energy data

Supply

- Kazakhstan is a major producer of all fossil fuels (coal, crude oil and natural gas).
- In 2018, Kazakhstan was the world's 9th-largest coal producer (108 million tonnes [Mt]). It ranked 17th in the world for crude oil production (91.9 Mt), and 24th for natural gas (38.7 bcm).
- It is the first energy producer among EU4Energy focus countries (16th in the world in 2018). It produces more than twice as much crude oil as Azerbaijan but around half the natural gas produced in Turkmenistan.
- Kazakhstan's total energy production (178 million tonnes of oil equivalent [Mtoe] in 2018) covers more than twice its energy demand.

Exports

- Kazakhstan is also a major energy exporter. In 2018, it was the world's 9th-largest exporter of coal, 9th of crude oil and 12th of natural gas.

Demand

- In 2018, Kazakhstan's energy consumption (measured by total primary energy supply) was 76 Mtoe, comparable to consumption in the Netherlands (73 Mtoe). Among EU4Energy focus countries, Kazakhstan is the second-largest energy consumer after Ukraine.
- Coal represents around half of Kazakhstan's energy mix (50% in 2018), followed by oil and natural gas (both with 25% shares).
- Coal is mostly transformed into electricity and heat before reaching the final consumer. Coal fuels around 70% of electricity generation (in 2018), followed by natural gas (20% in 2018).
- Total final consumption (TFC; excluding transformation processes) amounts to around 40 Mtoe (42 Mtoe in 2018).
- Industry is the primary final energy consumer (16 Mtoe in 2018), followed by the residential sector (11 Mtoe).
- Oil and coal together form over 50% of the final consumption. Share of natural gas is relatively low (13% share of TFC in 2018).

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Renewables

Renewable energy accounted for only 1.4% of the energy mix (TPES) in 2018. Share in electricity generation was 10.4% in 2018, of which most is hydro electricity. Generation from wind plants increased 18.3% from 2017 to 2018 (https://www.korem.kz/rus/o_kompanii/godovye_otchety/).

Energy sector governance

According to the Constitution, the president determines the strategic directions of domestic and foreign policy, and the executive branch is legally mandated to formulate its economic, social and other policies accordingly.

Executive

The newly formed **Ministry of Energy** is a key policymaking institution with regulatory authority over oil and gas extraction, oil refining, transportation of hydrocarbons, gas processing and distribution, power generation, coal production and nuclear energy.

The **Ministry of Industry and Infrastructural Development** is responsible for the development of the industry sector: industrial and innovative developments; scientific and technical developments; mining and metallurgical complex development; and local content, engineering, coal, chemical, pharmaceutical and medical industry development.

The newly founded **Ministry of Ecology, Geology and Natural Resources** (2019) is responsible for environmental protection policy, "green economy" development, waste management (excluding municipal, medical and radioactive waste), etc.

The **Ministry of National Economy** is responsible for developing a co-ordinated macroeconomic policy through strategic and budget planning.

The key task of the **Ministry of Finance** is to develop and implement budget policy.

Legislative

Legislative power is executed by a bicameral **parliament** composed of a senate (upper house) of 47 deputies and the *Mazhilis* (or *Majilis*) (lower house) of 107

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deputies. Kazakhstan's parliament amends the Constitution, approves the budget, programmes and government reports, adopts laws, decides whether the country is at war or peace, initiates referendums and ratifies international treaties, among other duties. It is currently implementing two presidential programmes: 100 Concrete Steps and Strategy Kazakhstan 2050. The Mazhilis does not typically play a policymaking role, but reviews policies developed and proposed by the government and enacts laws accordingly.

In early 2017, the **President** of Kazakhstan decided to transfer some presidential power (in regulating social and economic processes) to the parliament and the government. This transfer of power is only at a technical level, however: the president retains the status of supreme arbiter capable of regulating relationships among the legislative, executive and judicial branches of government, and of addressing issues of national security and the country's defence capabilities (http://khabar.kz/ru/arkhiv-zheti-kn/item/73940-zheti-kn-29-yanvarya-2017).

Judiciary

In Kazakhstan, there are a supreme court, local (regional, city and district) courts and specialised (military, juvenile and economic) courts; other specialised courts may also be created. The supreme court – the highest judicial body on civil, criminal, economic and other cases under the jurisdiction of the lower courts – exercises procedural forms of judicial supervision over their activities and provides explanations on issues of judicial practice.

In 2016, Kazakhstan's justice system was converted to a three-tier system (first, appeal and cassation) and the new Code of Civil Procedure entered into force. To improve its attractiveness for foreign investors, Kazakhstan plans to generalise the judicial practice of investment disputes. In matters of administrative and criminal humanisation of legislation, it plans to apply penalties and reasonable deadlines for their payment (http://www.kazpravda.kz/articles/view/sudebnaya-sistema--vazhnoe-zveno-uspeshnoi-realizatsii-poslaniya1/).

Regulatory framework

The Presidential Administration's Socioeconomic Monitoring Department controls realisation of the strategic directions set by the president. The Ministry of Energy performs most regulatory and control functions in the energy sector,

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and the Ministry for Investments and Development has regulatory authority over industrial safety as well as licensing of exports and imports, including energy products. Drafts of subsoil contracts and feasibility studies for upstream projects are examined for their potential economic effects by the Ministry of National Economy, and the Ministry of Finance's general regulatory functions include monitoring assets deemed strategic by the state. The Ministry of Labour and Social Protection of Population and the Ministry of Education and Science monitor energy projects to ensure they meet the requirements for hiring local Kazakh personnel (the 2010 Law on Subsoil Use requires that oil and gas producers source prescribed percentages of goods, services and personnel locally) (http://kazenergy.com/images/NationalReport15_English.pdf).

The Committee for Regulation of Natural Monopolies and Protection of Competition is the state body for protection of competition and restriction of monopolistic activities on the relevant commodities markets; for control and regulation of activities related to state monopoly within the limits provided by legislation; and for cross-sector co-ordination, regulation and control of natural monopolies and regulated markets. It is responsible for controlling and regulating the activities of energy-producing and energy-providing organisations in accordance with the Law on Electric Energy (http://www.kremzk.gov.kz/eng/).

Key policies

In 2012, the government launched the Kazakhstan 2050 Strategy defining the course for long-term economic development. It identifies social, economic and political reforms aimed at placing Kazakhstan among the top 30 global economies by 2050. Economic growth is to be achieved by reaching new export markets, improving the investment climate and further developing the private sector and public-private partnerships. The strategy stipulates that alternative and "green" energy technologies must generate up to 50% of all consumed energy by 2050. It also declares that all mining companies should transition to environmentally friendly production only.

In May 2013, the Green Economy Concept was adopted, setting the ambitious target of 50% electricity generation from sources other than coal or oil, including gas, nuclear and renewable energy, by 2050. The government plans to achieve this by phasing out ageing infrastructure, increasing the use of these alternative fuels, installing efficient energy technologies and complying with high ecological standards.

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The 100 Concrete Steps programme introduced in 2015 aims to boost transparency and accountability through structural reforms that will: 1) create a professional government apparatus; 2) ensure rule of law; and 3) improve industrialisation policy and promote growth. Steps include privatising agricultural lands to encourage their efficient use; optimising tax and customs policies and procedures; introducing a "single window" principle for customs procedures for exporters and importers; integrating customs and tax systems; simplifying the legalisation procedure for property and money; privatising state-monopolised examination of pre-design and design documents; and replacing outdated construction standards and rules with the eurocodes system. As part of the programme, the Astana International Financial Centre (AIFC) was opened in 2018 and one of its tools for attracting investors is investment residency. The government has also introduced reforms to support a favourable investment climate: rules for establishing a one-stop shop for investors were adopted in February 2015, and the Law on Investments was amended in December 2014, supported by a liberalised visa regime.

Energy statistics

Official energy statistics in Kazakhstan are the responsibility of the Committee on Statistics under the Ministry of National Economy.

In 2016, the energy data collection system was modified as part of modernisation efforts by the Committee on Statistics. In 2018 the Committee on Statistics conducted a household fuel and energy consumption survey, covering 21 000 households. This was Kazakhstan's first-ever household survey to specifically focus on energy consumption. The survey included various questions on fuel consumption for heating, cooking, water heating, etc., and the results are available on the Committee on Statistics website.

The main energy publication is the annual Fuel and Energy Balance of the Republic of Kazakhstan. It contains annual data on energy supply and demand in physical and energy units with sectoral breakdowns, as well as energy intensity indicators. The publication is available online in electronic format, and the layout follows that developed under the Soviet Union.

Official annual data is shared with the United Nations Statistics Division (UNSD) and the International Energy Agency (IEA) through five joint IEA/Eurostat/UNECE questionnaires. Monthly oil and gas data are also collected

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and transmitted to the UNSD for publication through the Joint Organisations Data Initiative (JODI), as well as to the Interstate Statistical Committee of the Commonwealth of Independent States (CIS).

The Committee on Statistics maintains an national energy statistics working group, bringing together data providers and data users (energy companies, researchers and ministry representatives) to improve the quality and use of energy data. Official energy statistics are actively used for electricity sector modelling by the Kazakh Research Institute of Power Engineering. Regional energy intensity indicators are used in regional development policy.

The Committee on Statistics has done major work in recent years on consolidating energy statistics, with some technical and financial support from the internationally funded Kazstat and INOGATE programmes. There are also plans to publish the energy balance in International Recommendations for Energy Statistics (IRES) format, in addition to the standard format, to increase both domestic and international use of national energy data.

Chapter 1. Energy security

Resource endowment

At the end of 2018, Kazakhstan's proved oil reserves were 3 900 Mt and the reserves-to-production (R/P) ratio was 42.7 (https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf); this amounts to 1.7% of the world's total liquid reserves and puts Kazakhstan in 12th place worldwide (https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf).

Kazakhstan is also rich in natural gas deposits, with 1 000 bcm of proved reserves at the end of 2018 (0.5% of total world reserves) at an R/P ratio of 40.7, and proven reserves of coal totalled 25 605 Mt (2.4% of total world reserves) at an R/P ratio of 217 (https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf).

There are 271 oil and 61 gas condensate fields in Kazakhstan. More than 90% of oil reserves are concentrated in 15 major fields, and about 70% of the country's proved and probable (2P) oil and gas condensate reserves are found in the five largest fields (Tengiz, Kashagan, Korolevskoye, Karachaganak and Zhanazhol).

Approximately 98% of Kazakhstan's natural gas reserves are located in the west, with 85% concentrated in just a few large fields (Tengiz, Kashagan, Karachaganak, Zhanazhol and Imashevskoye).

Energy security and diversification

Highly reliant on its significant fossil fuel resources, Kazakhstan is a net exporter of energy and energy products. However, some residents – in northern and central Kazakhstan – still do not have access to network gas because natural gas reserves are in the western part of the country, population centres are in the north, east and south, and the domestic pipeline system is underdeveloped.

Kazakhstan therefore relies on gas imports from Russia and Uzbekistan to meet domestic demand: a gas-swapping arrangement between Kazakhstan and Russia entails the replacement of Karachaganak gas, which has historically been supplied to Orenburg for processing, with imports of Central Asian gas to the southern part of Kazakhstan and Russian gas to the Kostanay region (https://www.kmgep.kz/eng/investor_relations/annual_reports/).

Activities are, however, under way to expand networks to increase overall access to gas. Following an order of the former president in 2018, construction of the Saryarka gas pipeline was begun to provide gas to the capital city of Nur-Sultan as well as central and northern Kazakhstan by 2023. Pipeline construction began in November 2018, and in October 2019 the first stage from Kyzylorda to Nur-Sultan was completed (https://ru.sputniknews.kz/economy/20191129/12161758/Vtoraya-ochered-gazoprovoda-Saryarka-otsenivaetsya-v-124-milliona-dollarov.html).

The pipeline's capacity will be 2.2 bcm of gas per year, and 171 settlements in the Karaganda and Akmola regions are expected to be provided with gas. These measures should improve the air quality of Nur-Sultan, as coal consumption is expected to decrease by 650 kt per year (https://inbusiness.kz/ru/last/stalo-izvestno-v-kakie-rajony-stolicy-v-pervuyu-ochered-provedut-gaz). In April 2020, installation of the main gas pipeline was being completed at Nur-Sultan (https://informburo.kz/novosti/v-nur-sultane-montazh-magistralnogo-gazoprovoda-nahoditsya-na-stadii-zaversheniya.html).

Strong economic growth and a rising standard of living are expected to boost energy demand considerably in upcoming years. To meet this rising demand in a reliable, affordable and sustainable manner, the government plans to expand generation capacity from various fuel sources through new investments and modernisation of existing capacity. However, construction of a 2 640-megawatt (MW) coal-fired power plant at Balkhash Lake was suspended in 2016 because the Ministry of Energy decided that modernisation of power plants to date, the creation of substantial reserves and a decline in energy consumption growth render this plant unnecessary before 2022 (http://ratel.kz/kaz/v_kazahstane_ne_budet_elektrostantsii_samsung).

According to Kazenergy's 2015 report, the availability of low-cost coal means the established fleet of large coal-fired power plants will continue to dominate until 2040, although gas-fired generation will also increase as Kazakhstan's gas network expands. Kazenergy expects only modest growth in renewable energy production due to its intermittent nature and the technical and economic issues of integrating renewables into Kazakhstan's unified energy system, unless there are significant

changes in technical reliability in either renewables production (wind and solar in particular) or in grid operations (http://kazenergy.com/images/National Report15_English.pdf).

Low liquefied petroleum gas (LPG) prices have raised demand for the product. The LPG market is regulated, with the government setting a price limit on LPG every quarter, but there has been a deficit of LPG in the domestic market due to illegal exports to neighbouring countries where the price is much higher. Because low maximum wholesale prices and increased consumption in the domestic market have led to losses and deteriorating financial and economic conditions for the owners and producers of LPG, the Ministry of Energy had planned to phase out state regulation of wholesale prices (http://energo.gov.kz/index.php?id=49), but in 2019 regulation was still in place with the Minister of Energy approving a maximum LPG price (https://www.zakon.kz/4986539-predelnye-tseny-na-szhizhennyy-gaz.html).

Modernisation of the three refineries, completed in 2018, has helped reduce the need to import light crude oil products. Refinery throughput increased 10% in 2018 to 16.4 Mt, providing 93% of the domestic market's gasoline supplies, 91% of its diesel and 62% of its jet kerosene (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf). New refinery capacities are expected to completely meet domestic needs by 2030.

Energy co-operation between Kazakhstan and China is based mainly on China's need to import energy for development and to diversify its import sources, and on Kazakhstan's aim to diversity its export routes and expand export volumes. China is a key strategic energy sector partner, with Chinese companies involved in Kazakhstan's energy development, mainly hydrocarbons, including upstream development and pipeline construction as well as domestic oil refining and gas processing. China's equity shares in Kazakhstan's oil production have increased rapidly, reaching 25% in 2009, and the 2013 visit of Chinese President Xi Jinping led to the signing of energy deals worth USD 30 billion, including the China National Petroleum Corporation (CNPC) acquisition of an 8.3% stake in Kashagan, the largest oilfield in the world outside the Middle East (http://astanatimes.com/2014/01/energy-cooperation-kazakhstan-china/).With completion of the Beyneu-Bozoy-Shymkent natural gas pipeline in 2015 (capacity of 15 bcm per year), exports to China increased to 5.2 bcm in 2018. (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).

The treaty establishing the Eurasian Economic Union (EAEU) came into force on 1 January 2015, the member states being Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia. (http://www.eurasiancommission.org/en/Pages/default.aspx). The core objective was the free movement of goods, capital, services and people within the single market. Although the EAEU eliminated customs duties on trade among its member states, it excluded most energy commodities from its general trade rules. Rather, energy trade among Customs Union members is governed largely by special bilateral trade agreements (http://kazenergy.com/images/NationalReport15_English.pdf). According to the EAEU treaty, a common electricity market was to be operational by 1 July 2019, while the common markets for gas, oil and petroleum products are to be in place by 1 January 2025. (http://www.eurasiancommission.org/en/nae/news/Pages/17-11-2015-15.aspx). In May 2019, heads of EAEU countries signed an agreement on a common electricity market. It is expected to begin functioning when the rules on common trade enter into force (https://ria.ru/20190530/1555095463.html).

Oil product tariffs (except for A-80 and LPG) have been freed from direct state regulation: in December 2014 gasoline grades A-80, A-92 and A-93 as well as diesel and LPG were regulated, while in September 2015 state regulation was lifted for gasolines A-92 and A-93 and in July 2016 diesel was also excluded. The government will continue to administratively influence the prices of certain types of refined products (A-80 and LPG) until refinery modernisation is complete (http://www.kazenergy.com/upload/document/energy-report/National_Energy_Report-ENGLISH_03.09.pdf).

Kazakhstan's retail prices for oil products continue to be among the lowest in the world (https://inbusiness.kz/ru/news/toplivo-v-kazahstane-ostaetsya-odnim-iz-deshevyh-v-mire). Even though administrative price reduction was phased out during 2014-16, Kazenergy (2019) reports that the Committee for the Regulation of Natural Monopolies, Protection of Competition and Consumer Rights often fines retail stations for "anti-competitive" pricing practices and thereby keeps retail prices low (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf). Since April 2020, large gas stations in Kazakhstan have reduced their retail gasoline and diesel fuel prices as a result of government support measures, even though such administrative price reductions will affect their profitability all the way from production to retail (https://inbusiness.kz/ru/news/toplivo-v-kazahstane-ostaetsya-odnim-iz-deshevyh-v-mire).

Energy infrastructure and investment

Electricity

The Kazakhstan Electricity Grid Operating Company (KEGOC) reported that total installed capacity in Kazakhstan was 21.9 gigawatts (GW) on 1 January 2019, of which 18.9 GW was available capacity (https://www.kegoc.kz/ru/elektroenergetika/elektroenergetika-kazahstana-klyuchevye-fakty). Disaggregated data on the installed capacity of power plants by type are not available from official sources. Coal-fired plants account for 70.4% of power generation, mostly located in central, northern and eastern Kazakhstan. The 76 power plants connected to Kazakhstan's unified energy system are grouped into three general categories for purposes of dispatch and operation: plants of national significance, plants of regional significance, and industry-owned facilities.

During the "tariff for investment" period, electricity investments rose (especially in 2009-15). Nevertheless, in 2017 depreciation rate for nearly 36% of turbine equipment at existing thermal power plants was still over 75% (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).

Heat is produced by 40 co-generation plants (45% of total heat energy production), 28 large boilers (35% of production) and 886 small boilers of less than 100 gigacalories per hour (Gcal/h) (20% of production) (http://kazenergy.com/images/NationalReport15_English.pdf). The heating network is 11 500 km long and transmission losses are 30%.

Kazakhstan maintains over 71 600 km of high-voltage transmission lines, mainly of 110 kilovolts (kV) and 220 kV. Of this total, KEGOC owns and operates 25 097 km of 0.4-kV to 1 150-kV high-voltage lines and 78 electric power substations with installed transmission capacity of 36 660 megavolt-amperes (MVA)(https://www.kegoc.kz/en/shareholders-and-investors/information-disclosure/annual-reports/2018). KEGOC constructed more than 1 700 km of lines and three new 500-kV substations between 2014 and 2018: Semey, Aktogay and Taldykorgan. In 2018, KEGOC commissioned the high-voltage 500-kV Shulbinskaya hydropower plant (HPP) Semey-Aktogai-Taldykorgan-Alma transmission line, which is the final stage of North-East-South 500-kV Electricity Transmission Construction Project (https://www.kegoc.kz/en/shareholders-and-investors/information-disclosure/annual-reports/2018).

Kazakhstan has three main oil refineries as well as a number of mini plants with total annual capacity of 18.3 Mt. In 2018, modernisation of three major refineries was accomplished at a cost of USD 6 billion, reducing Kazakhstan's dependency on oil product imports from Russia. Oil refining amounted to 16.4 Mt in 2018, a 1.5-Mt increase from 2017. Since being modernised, Kazakhstan's refineries can produce K-4 and K-5 fuels (corresponding to the Euro 4 and Euro 5 grades) (https://www.kazenergy.com/upload/document/energy-report/National Report19_en.pdf).

Kashagan is one of the ten largest oilfields discovered in the world in recent years, at a cost of USD 50 billion; the first oil was extracted in September 2013, but after one month it was shut down due to pipeline leaks resulting from sulphide stress cracking. In January 2017, production at Kashagan field reached 180 000 barrels per day (b/d) following resumption of production in October 2016. Production capacity of Kashagan Phase 1 was expected to reach 370 000 b/d (http://oilprice.com/latest-energy-news/world-news/kashagan-production-ramping-up-to-180000-bpd.html). Kashagan's output was 8.3 Mt in 2017 and 13.2 Mt in 2018, and daily production, which was variable because operations were suspended during part of April and May due to maintenance and repairs, reached 375 000 b/d in July. Kazenergy (2019) has reported that Kashagan could reach its maximum output of 45 Mt in 2040 (955 000 b/d). (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).

To facilitate oil exports to China, Kazakhstan launched the first stage of its cross-border oil export pipeline to China, the 962-km, 10-Mt/y Atasu-Alashankou pipeline, in December 2005. At a cost of USD 700 million, the pipeline was built as a 50-50 joint venture between the national Kazmunaygas (KMG) company's subsidiary KazTransOil (KTO) and CNPC subsidiary China National Corporation for Exploration of Oil and Gas (http://kazenergy.com/images/nationalreport15_english.pdf). At the end of 2015, oil transportation through the Atassu-Alashankou pipeline in the direction of China was 11.8 Mt (http://www.kmg.kz/en/manufacturing/oil/kazakhstan_china/), while in 2018 oil transportation through the Kazakhstan-China pipeline dropped by 48% to 1.4 Mt (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf). In 2019, however, over 10.9 Mt of crude oil was delivered to China through the Kazakhstan-China pipeline (https://oilcapital.ru/news/export/21-01-2020/pochti-11-mln-tonn-nefti-poluchil-kitay-iz-kazahstana-v-2019-godu), and in January 2020 Kazakhstan had to suspend exports of oil to China due to poor

fuel quality caused by an excess of organochlorine compounds (https://ru.sputniknews.kz/economy/20200128/12664743/eksport-kazakhstan-neft-china-minenergo.html).

Kazakhstan's distribution pipelines reached a total length of 49 000 km in 2019. In 2015, domestic gas consumption was 12.1 bcm, or more than 2.5 times consumption in 2000 (http://www.kaztransgas.kz/files/KTG_annual_report_2015_eng.pdf). It rose to 13.7 bcm in 2017, 14.9 bcm in 2018 and 15.1 bcm in 2019 (https://www. kaztransgas.kz/images/01_reports/annual-2019-rus.pdf). The South Kazakhstan Region (or *Oblast*) has been receiving gas from the Aktobe Region since completion of the Beineu-Bozoi-Shymkent pipeline in 2016 connecting western Kazakhstan with the densely populated southern region. With a capacity of 10 bcm/y, this line decreases Kazakhstan's dependency on Uzbek and Turkmen gas (http://energo.gov.kz/index.php?id=49). It also connects to Line C of the Central Asia Gas Pipeline (CAGP) network to eventually supply exports to China (http://kazenergy.com/images/NationalReport15_English.pdf). As part of actions to increase the capacity of the Beineu-Bozoy-Shymkent gas pipeline from 10 bcm/y to 15 bcm/y, three compressor stations were commissioned in April 2019 (https://www.kaztransgas.kz/images/01_reports/annual-2019-rus.pdf).

Pipeline gas is currently available in only 10 of Kazakhstan's 14 regions, with the 4 remaining regions in the north and centre relying on coal and LPG. More than 3 million people have gained access to piped gas in the past seven years, with connections expanding from 30% in 2013 to 52% in 2019 and amounting to more than 9 million citizens. In December 2019, the first section of the Saryarka gas pipeline was commissioned. It is expected to provide natural gas to the Central Kazakhstan cities of Nur-Sultan, Karaganda, Temirtau and Zhezkazgan, and to 171 settlements along the main gas pipeline (approximately 2.7 million people) by 2040 (https://www.kaztransgas.kz/images/01_reports/annual-2019-rus.pdf).

One of the largest investment projects in the oil and gas industry is the Kazakhstan-China gas transit pipeline. In 2016, construction of three lines of the transnational Turkmenistan-Uzbekistan-Kazakhstan-China gas pipeline were completed, to eventually allow transit gas volumes to increase from 30 bcm/y to 55 bcm/y when compressor stations in Line C are operational (http://www.kaztransgas.kz/files/KTG_annual_report_2015_eng.pdf). Expansion of the Beineu-Bozoy-Shymkent pipeline's capacity is expected to increase stable export supplies of marketable gas to China to 10 bcm per year.

KazTransGaz (KTG) is responsible for improving and developing the country's gas infrastructure. In 2010, it began constructing compressed natural gas (CNG) filling stations and delivering CNG to improve the region's environmental situation and to develop gas for transport (http://www.kaztransgas.kz/files/KTG_annual_report_2015_eng.pdf accessed 04.02.2017).

Coal

Coal is transported mainly by rail, as Kazakhstan has a sizeable rail system operated by the state-owned national company Kazakhstan Temir Zholy joint-stock company (NC KTZ JSC). Although coal is essentially a low-margin line of business for the rail industry, it is crucial because it constitutes the greatest turnover (in tonnes shipped and in tonne-kilometres [tkm]) of any single product for the railroad system.

High transportation costs, due to long distances between production sites and consumers, render Kazakhstan's coal relatively expensive for consumers and reduce its competitiveness even in the Russian market. In fact, up to 40% of the final price of coal is made up of transportation costs (https://inbusiness.kz/ru/news/ugolnoj-otrasli-nuzhna-gospodderzhka). Because tariffs for using the main railway networks and railway services increased in 2019, the Association of Mining and Metallurgical Enterprises has called for state support of the coal industry (https://inbusiness.kz/ru/news/ugolnoj-otrasli-nuzhna-gospodderzhka).

Around 25-30% of total coal produced is exported (mainly to Russia), but due to the limited competitiveness of Kazakhstan's coal in international markets and the expected decline in exports to Russia, the domestic power sector is expected to become the main consumer of Kazakh coal.

Kazakhstan's coal mines are particularly gassy and coal mine methane (CMM) accumulates to concentrations of up to 33 cubic metres (m^3) per tonne in deep coal mines in the Karaganda basin, making its removal ("drainage") a safety imperative. Among KTG's investment activities is a prospecting project to produce CMM at Karaganda coal basin. However, a pre-feasibility study of CMM in Karaganda showed that CMM quality in the mines is not sufficient at current gas market prices to support projects for CMM enrichment for pipeline, CNG, or liquefied natural gas (LNG) applications. Nevertheless, it has been demonstrated that small-scale electricity generation at the production sites could be feasible (http://kazenergy.com/images/NationalReport15_English.pdf).

Emergency response

Kazakhstan has no specific programmes for emergency response in the energy sector. The Committee for Nuclear and Energy Regulation and Control is responsible for the readiness of power plants and electricity networks for the autumn-winter period. It also monitors the reliability and safety of electricity production, transmission, supply and consumption. The committee inspects the technical condition of power plant, grid and consumer energy equipment. In addition, it keeps records on investigations of significant consumer electricity blackouts and damage to large power equipment, and its investigations of major technological failures in the power and electricity networks led to the unified energy system being divided into several parts.

Departments of energy and housing utilities of local administrations (*akimats*) are responsible for the stable operation of heat sources and electrical networks, provision of normative fuel supplies, uninterrupted provision of electricity and heat to the cities and districts of the region, and equipment repairs for the upcoming heating season.

The government of Kazakhstan adopted a National Plan for the Prevention of Oil Spills and Response at Sea and Inland Waters in 2012 (https://egov.kz/cms/ru/law/list/P1200000422), and the Kazakhstan Upstream Oil and Gas Technology and R&D Roadmap considers emergency response and disaster recovery as a part of the health, safety and environment (HSE) department's operations (http://kazenergy.com/images/NationalReport15_English.pdf).

Chapter 2. Market design

National market structure

Electricity

The electricity market has two levels, wholesale and retail, and the heat power market has only a retail level. Electricity generation in Kazakhstan is carried out mainly by private enterprises. The electricity transmission system operator (TSO) is state-owned KEGOC, and 21 regional distribution companies act as distribution system operators (DSOs). The retail market is competitive, with approximately 45 companies.

The wholesale electricity market in Kazakhstan comprises:

- a decentralised market (bilateral contracts of electricity purchase and sale)
- a centralised market based on purchase and sale of electricity for short-term (spot trade), mid-term (weekly, monthly) and long-term (quarterly, yearly) periods
- a real-time balancing market
- a system and ancillary services market
- a capacity market (since 1 January 2019) (http://www.kegoc.kz/en/power-industry/kazakhstan-electric-power-industry-key-factors).

Daily schedules of wholesale market activity are prepared, and the dispatch of day-ahead load management is based on these schedules. DSOs work with the regional control centres for dispatch to retail customers, and state-owned KOREM administers the day-ahead market, develops preliminary dispatch schedules and implements actual supply/demand balances.

Kazakhstan's Electric Capacity Reserve Pool (ECR Pool) was established by electricity market participants to provide contract-based capacity reserves to ensure an uninterrupted power supply for consumers (founders of the ECR Pool) in case of generating capacity failures and transmission line outages (www.kegoc.kz/sites/default/files/content-manager/ar2015-kegoc_eng_smrt.pdf).

The Financial Settlement Centre for Support to Renewable Energy Sources LLP (www.kegoc.kz/sites/default/files/content-manager/ar2015-kegoc_eng_smrt.pdf)

ensures that electricity produced by renewable energy facilities is centrally purchased, sold and delivered to Kazakhstan's Unified Power System (UPS) electricity networks.

For the first time in Kazakhstan's history, at the end of 2018 KOREM organised centralised bidding for electricity generation capacity, with all bidders being energy-producing enterprises.

According to KOREM, total centralised trading market transactions in 2018 amounted to 21.3 billion kilowatt hours (kWh) (48% of the electricity transmitted through JSC KEGOC's national networks), including:

- 21 billion kWh from mid- and long-term centralised trading
- 97.6 million kWh from day-ahead spot trading
- 114.1 thousand kWh from same-day spot trading.

Oil

State-owned KMG is an integrated national oil and gas company implementing national policies on oil and gas sector developments and is involved in oil and gas exploration, production, refining, transportation, distribution and servicing. The company also establishes management systems for subsoil use.

Kazakhstan's "Big 3" projects are the Tengis Consortium (TCO), the Kashagan Consortium (NCOC) and the Karachaganak Consortium (KPO), responsible for 54 Mt of oil production (60% of Kazakhstan's total output). KMG owns equity in these three projects, and in 2018 its total equity in crude oil production was 23.6 Mt (38% of which was in the Big 3), while its fully owned subsidiaries are UzenMunayGas (5.5 Mt of production) and EmbaMunayGas (2.9 Mt). CNPC owns majority stakes in AktobeMunayGas and PetroKazakhstan, parity ownership in North Buzachi, and stakes in NCOC. In addition, 78 smaller companies produced 9 Mt of oil (10.5% of total output) (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).

KTO, nominally a subsidiary of KMG, owns the main network, and certain other pipelines are owned and operated by consortiums of investors in which KTO is a shareholder (Caspian Pipeline Consortium [CPC] exports through Russia to world markets, and the Atasu-Alashankou and Kenkiyak-Atyrau pipelines export to China). The three main refineries are owned by KMG, although Shymkent is owned by a joint venture between KMG and CNPC.

Oil product marketing and distribution is reasonably competitive, with multiple companies operating over 4 000 retail stations in the country. The three largest retail chains are KMG, Helios and SinoOil, together holding 16% of the retail market.

Two types of contracts for subsoil use have been employed in Kazakhstan: production sharing agreements (PSAs) and regular contract regimes. In January 2009, however, a Tax Code was introduced with stricter provisions than previous tax legislation. Under this Code, PSAs were no longer permitted and the Code alone established provisions for the payment of taxes and levies relating to subsoil operations, although the small number of PSAs already concluded prior to 2009 were "grandfathered" (i.e. considered exempt from the new Tax Code) (http://kazenergy.com/images/NationalReport15_English.pdf). New amendments to the Tax Code (effective 1 January 2018) introduced an alternative tax option to stimulate upstream exploration and investment development of offshore and ultra-deep hydrocarbon deposits (https://www.inform.kz/ru/v-kazahstane-vveden-alternativnyy-nalog-na-nedropol-zovanie_a3410605).

In November 1997, the North Caspian Sea Production Sharing Agreement (NCSPSA) was signed, and in January 2009 the NCOC took over from Agip KCO as operator under the NCSPSA. NCOC acts on behalf of a consortium of seven international companies: KMG, Eni, Shell, ExxonMobil, Total, ConocoPhillips and INPEX.

Gas

Most gas pipeline infrastructure in Kazakhstan, except for pipelines built for specific projects (e.g. CAGP), is owned and operated by KTG, an affiliate of the fully state-owned enterprise KMG and a vertically integrated TSO/DSO holding company. Regional gas distribution and sales also are carried out by KTG and its subsidiaries, and gas processing is done at four major gas processing plants (GPZs) built by specific upstream projects. KMG owns one legacy plant (KazGPZ) operating in Mangistau Region (http://kazenergy.com/images/NationalReport15_English.pdf).

Coal/peat

As of April 2014, 12 large coal producers in Kazakhstan, both private and state-owned, held 98% of national output. The private company Eurasian Resources Group (ERG) has about 30% shares in the country's total production of steam coal, while Samruk-Energo (representing state interests) and RUSAL (privately

owned Russian Aluminium) each hold about 20%. Almost all coking coal is produced by privately owned ArcelorMittal (mainly for its own use at the Karaganda steel plant).

Coal is shipped to domestic and international consumers using the railway network managed by the state-controlled monopoly NC KTZ JSC (http://kazenergy.com/images/NationalReport15_English.pdf).

Nuclear

State-controlled KazAtomProm (KAP) (http://www.kazatomprom.kz/en) is the main company in the nuclear industry, but most mining activity is done through joint ventures between KAP and foreign investors. Its entitlement production is about 56% of Kazakhstan's total output. Kazakhstan has 22 uranium production contracts, with 70% of production volumes generated by KAP's joint ventures with foreign investors (http://kazenergy.com/images/NationalReport15_English.pdf).

Uranium oxide exports are tightly regulated by the state and specially designed railway cars are used to transport uranium to export markets.

Large hydro

Kazakhstan's major hydroelectric stations are in the east and south, mainly on the Irtysh River. The Shulbinskaya HPP is the third station in the Irtysh cascade of HPPs and the largest in Kazakhstan in terms of installed capacity (702 MW) (https://shges.kz/). The Ust-Kamenogorsk HPP with installed capacity of 355.6 MW is the second stage of the Irtysh cascade of HPPs and it serves as the counter-regulator of the Bukhtarma HPP (https://www.ukges.kz/). The Bukhtarma HPP has 9 units of 75 MW each, with a total capacity of 675 MW (http://kazzinc.com/ru/%D0%91%D1%83%D1%85%D1%82%D0%B0%D1%80%D0%BC%D0%B8%D0%BD%D1%81%D0%BA%D0%B8%D0%B9_%D0%B3%D0%B8%D0%B4%D1%80%D0%BE%D1%8D%D0%BD%D0%B5%D1%80%D0%B3%D0%B5%D1%82%D0%B8%D1%87%D0%B5%D1%81%D0%BA%D0%B8%D0%B9_%D0%BA%D0%BE%D0%BC%D0%BF%D0%BB%D0%B5%D0%BA%D1%81). The Bukhtarma HPP, which is part of the Kazzinc company under a long-term concession, is integrated into Kazakhstan's national energy system as the peak-load power plant that regulates the energy supply.

Large HPPs in southern Kazakhstan include Moinak HPP JSC (300 MW) (https://moynak.kz/ru/) and SC AIES Kapchagay HPP (364 MW) (http://www.ales.kz/ru/about-company/35-podrazdeleniya/70-ales-kapchagajskaya-ges).

Renewable energy

Since fixed rates for renewable energy were introduced in 2014, there have been significant renewable energy developments in Kazakhstan. In 2017 auctions for renewable energy were introduced, in addition to the existing fixed feed-in-tariff support system. The Ministry of Energy expects that auctions will reduce the cost of electricity generated from renewable energy sources (https://abctv.kz/ru/last/pervye-aukciony-vie-v-kazahstane-provedut-v-aprele-2018-god). Auctions aim to select feasible projects and establish competitive prices for renewable electricity.

At the end of 2019, Kazakhstan had 90 renewable energy facilities with a total installed capacity of 1 050 MW (284 MW of wind power plants; 542 MW of solar power; 222 MW of small hydroelectric power stations; and 2.4 MW of bioenergy). At least 3 000 MW of installed capacity is expected to be operational by 2025, since contracts with a single purchaser Financial Settlement Centre of Renewable Energy for 2 600 MW have already been concluded (210 MW are in the process of being concluded and 190 MW have been concluded through bilateral agreements).

Auction rates are also subject to annual indexation: 30% for inflation and 70% for changes in foreign exchange rates.

Energy efficiency

The government body primarily responsible for implementing energy efficiency policies is the Ministry of Industry and Infrastructure Development. Other responsible bodies are the Ministry of Education and Science, 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 (http://www.iea.org/publications/freepublications/publication/PC_CleanEnergyTechnologyAssessmentMethodologyPilotStudyKazakhstan_WEB.pdf).

In October 2017, a mechanism to financially support energy service projects (i.e. subsidised loans) was launched in co-operation with the United Nations Development Programme (UNDP), the Ministry of Investment and Development of the Republic of Kazakhstan and the JSC Damu Entrepreneurship Development Fund. The Damu fund works on a revolving format, so that money invested in energy-saving projects returns to banks that will then continue to lend to green projects (https://expertonline.kz/a15778/). By February 2020, 100 projects in the amount of more than KZT 11 billion had been supported, 36 of which (worth KZT 2.1 billion) have already been implemented. These projects aim to improve the energy efficiency of residential and public buildings as well as tourist facilities; install LED lighting; modernise boiler and pump installations; and enlarge the use of renewable energy sources.

Financial and market factors for the development of energy efficiency and for investment in energy-efficient technologies in the industry sector are not encouraging. There is no one fund dedicated to financing energy efficiency programmes, and no specific financial instrument for offering loans with favourable options to enterprises for investing in planned measures. Kazenergy also stressed the predominance of restrictive mechanisms in the established legal framework, with a virtual absence of investment-encouraging provisions or incentives. Many legislative requirements adopted in relation to industry sector energy consumption (energy consumption standards, capacity factor requirements, and a ban on incandescent lighting fixtures) have not yet yielded substantial positive results (http://kazenergy.com/images/National Report15_English.pdf).

According to Kazenergy (2019), only eight energy service contracts were concluded during 2015-18. The limited employment of energy services contracts results from complicated return-on-investment procedures (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf). Amendments to the Law on Energy Conservation and Energy Efficiency were therefore developed and discussed in 2020, including support measures for energy service contracts: i) reimbursing part of energy service companies' costs for implementing energy-saving and energy-efficiency projects; and ii) subsidising part of the remuneration and/or offering partial guarantees for borrowed funds.

Another obstacle is that energy service companies' lack of collateral prevents them from developing projects at scale. The draft law therefore proposes partial guarantees on loans issued by financial institutions and also includes clauses giving investment preference to energy service companies for large-scale development of energy service projects. For sectors not covered by the State

Energy Register, it is suggested that voluntary energy audits be conducted to allow for any irrational use of energy resources to be identified quickly. Two types of energy audits (mandatory and voluntary) are defined, divided into full, targeted and express energy audits.

Furthermore, the draft law authorises local municipalities to develop, approve and implement energy saving roadmaps. It also envisages the development and implementation of a long-term National Population-Oriented Information Campaign.

Regulatory framework

Energy efficiency

The Law on Energy Conservation and Energy Efficiency with amendments and additions of 15 January 2019 is the primary legislation governing energy efficiency measures in Kazakhstan (https://online.zakon.kz/Document/?doc_id=31112351#pos=2;-106).

The IEA has proposed 25 cross-sectoral recommendations that have been partially implemented by Kazakhstan:

- **Data collection and indicators.** The Committee of Statistics publishes the Fuel and Energy Balance of the Republic of Kazakhstan; however, it does not comply with IEA format and energy efficiency indicators are difficult to track. Surveys to specifically track energy efficiency in the industry sector have not been conducted in Kazakhstan, so national action plans use energy intensity of GDP as a main indicator for energy efficiency, and sectoral energy efficiency indicators are not used to track improvements. Surveys on fuel and energy consumption in households were conducted in 2018, and household energy efficiency indicators are to be developed.
- **Strategies and action plans.** The Energy Efficiency 2020 Programme adopted in 2013 was declared to be no longer in force (http://adilet.zan.kz/rus/docs/P1300000904).
- **Competitive energy markets, with appropriate regulation.** Regulated retail tariffs are not fully cost-reflective and do not always account for the cost of modernisation. Much of the distribution sector is therefore stagnant and unable to replace obsolete infrastructure. Consumers are unaware of the true cost of energy and are not given incentives to save energy or to gain an understanding of its true cost. According to the Organisation for Economic Co-operation and Development (OECD), in 2011 in Kazakhstan the average fossil fuel subsidy covered about 33% of the full cost of supply. Estimated total fossil fuel subsidies

in 2011 were USD 5.85 billion, which was about 3.3% of the country's GDP. Most of the subsidies went to oil and petroleum products (55%), followed by electricity (30%) and coal (10%) (https://www.oecd.org/env/outreach/Energy%20subsidies%20and%20climate%20change%20in%20Kazakhstan.pdf).

- **Private investment in energy efficiency.** Restrictive mechanisms predominate in the legal framework, with virtually no investment-encouraging provisions or incentives (http://kazenergy.com/images/NationalReport15_English.pdf).
- **Monitoring, enforcement and evaluation.** As per the Law on Energy Conservation and Energy Efficiency, the state is responsible for the accuracy of information provided to the State Energy Registry on meeting energy efficiency requirements for buildings, on complying with energy consumption norms, on conducting energy audits and on implementing energy management systems. For the Energy Efficiency 2020 Programme adopted in 2013 but no longer in force, no information was found on its monitoring and evaluation.
- **Mandatory building codes and minimum energy performance standards (MEPS).** According to new legal acts, the main indicator of building energy efficiency is the classification system that assesses how efficiently a building uses heat. Permitted classes of energy efficiency of new and renovated buildings are: A (very high), B (high) and C (normal). Thus, minimum heating needs should be below level-C heating-need values (https://www.zakon.kz/4515580-mint-rk-i-proon-razrabotali-trebovanija.html). All new buildings must have metering devices and automated heat supply stations under the Law on Energy Conservation and Energy Efficiency.
- **Aiming for net-zero energy consumption in buildings**. This has not been addressed in the current legislation.
- **Improving the energy efficiency of existing buildings.** The Law on Energy Conservation and Energy Efficiency introduced energy service contracts under which specialised energy service companies provide a set of services for saving energy: the company's own expenses are reimbursed, and it profits financially from any energy savings achieved. Another incentive to improve energy efficiency is a different tariff for heat for consumers who have a heat metering device installed.
- **Energy labels or certificates for buildings.** The energy efficiency class of an existing building is determined by audit results, and it is then specified in the technical passport of the building; the energy audit is also attached to the building's technical passport.
- **Improved energy performance of building components and systems.** This has not been addressed in the current legislation.
- **Mandatory MEPS and labels for appliances and equipment.** According to the Law on Energy Conservation and Energy Efficiency, all energy-consuming equipment must have an energy efficiency class label. The list of energy-consuming devices to which this requirement applies is established in the technical regulations of the Customs Union, which define the class categories

and energy efficiency characteristics. Assessment and labelling are done by the manufacturer or importer.

- **Test standards and measurement protocols for appliances and equipment.** No information is available.
- **Market transformation policies for appliances and equipment.** No information is available.
- **Phaseout of inefficient lighting products and systems.** Selling and using electric incandescent lamps of 25 W and above has been prohibited (effective 1 January 2014), as is the procurement of such lamps by state agencies and entities, and by the quasi-public sector. However, construction norms and regulations on natural ambient lighting and artificial lighting adopted in 2002 do not correspond with modern requirements on energy efficiency, so updated construction norms that take new energy efficiency requirements and the prohibition of incandescent lamps into account are needed (http://www.kazenergy.com/images/stories/dor_karta/obzor_effect.pdf). Although requirements for energy-efficient lighting are expected to become more stringent, there are obstacles to widespread use, particularly a lack of quality control of products on the market. It is therefore necessary to develop methods to assess the quality of lighting products and to amend construction norms (http://lighting.eep.kz/en/). According to the latest Kazenergy report (2019), despite the ban on incandescent lamps taking effect five years ago, 60% of households still use incandescent lamps (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).
- **Energy-efficient lighting systems.** No information was found on measures to promote energy-efficient lighting systems. Kazenergy recommends that incentives in the form of grants or subsidies be introduced to help regional and local authorities install high-performance public street lighting throughout the country as soon as possible.
- **Mandatory vehicle fuel efficiency standards.** Kazakhstan's large refineries were designed to produce low-octane gasoline grades such A-72 and A-76, but there are numerous additives in the production process that affect the quality of the fuel and ultimately the efficiency of combustion engines (http://www.energycharter.org/fileadmin/DocumentsMedia/Thematic/EE-Kazakhstan_2014_en.pdf). Originally, Kazakhstan was to produce and handle Euro 4 and Euro 5 motor fuels from 1 January 2016, but the Council of the Eurasian Economic Commission amended the relevant technical regulations so that the use of Euro 2 and Euro 3 gasoline and diesel fuel was extended to 1 January 2018 (https://kapital.kz/economic/46044/chto-meshaet-npz-rk-vypuskat-benzin-evro-4-i-evro-5.html). Owing to the modernisation of three oil refineries in 2018, they are now able to produce K-4 and K-5 fuels (corresponding to the Euro 4 and Euro 5 grades).
- **Measures to improve vehicle fuel efficiency.** In 2015 requirements for the efficiency of transport (road, aviation, rail, marine and electric) were adopted with Ministry for Investments and Development Order No. 342 of 26 March 2015 on

Approval of the Permissible Parameters of Vehicles Intended to be Driven on the Roads of the Republic of Kazakhstan (https://tengrinews.kz/zakon/pravitelstvo_respubliki_kazahstan_premer_ministr_rk/tpanspopt/id-V1500010962/). Among other things, the order mandates Euro-4 emission standards and year-of-manufacture restrictions for vehicles. However, there are financial and economic barriers to reducing transport energy consumption, and no stimulus has been offered for the introduction of energy-efficient transportation. The lack of fuel efficiency labelling for new vehicles is another problem, and car exhaust quality should be inspected annually (http://www.alatransit.kz/sites/default/files/energy_efficiency_in_transport_sector_of_the_republic_of_kazakhstan.pdf).

- **Fuel-efficient non-engine components.** Energy efficiency labelling of tyres is not being conducted (http://www.alatransit.kz/sites/default/files/energy_efficiency_in_transport_sector_of_the_republic_of_kazakhstan.pdf).
- Improved vehicle operational efficiency through eco-driving and other measures. There is no information available.
- **Transport system efficiency.** Transport system efficiency, involving urban planning, the optimal integration of residential, business, commercial and cultural zones, and the adequacy of public transportation, is low but improving. The lack of navigation-time systems to optimise transport logistics seriously hinders public transport energy efficiency (http://www.alatransit.kz/sites/default/files/energy_efficiency_in_transport_sector_of_the_republic_of_kazakhstan.pdf).
- **Energy management in industry.** The State Energy Registry was established for industrial enterprises consuming more than 1 500 tonnes of coal equivalent (tce) per year, and energy audits at least every five years are mandatory. All subjects of the Energy Registry with annual energy consumption of at least 100 000 tce can voluntarily sign an agreement with the state authority and local municipality to reduce energy consumption by 15% within five years. (http://kazenergy.com/images/NationalReport15_English.pdf). Previously, the Law on Energy Conservation and Energy Efficiency's Article 10 (on energy management) required large enterprises to conduct energy audits and develop energy saving action plans, but it was excluded in 2015. According to the Kazenergy (2019), fines or other penalties for failure to implement energy saving programmes were never established, which resulted in limited execution. Additionally, procedures to conduct energy audits and to monitor their results have not yet been fully developed (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).
- **High-efficiency industrial equipment and systems.** Under the Law on Energy Conservation and Energy Efficiency, all energy-consuming equipment must have an energy efficiency class label, but no measures relate to industrial equipment specifically.
- **Energy efficiency services for small and medium-sized enterprises (SMEs).** In 2018, the government-UNDP project tested a financial support mechanism that subsidised part of energy conservation and energy efficiency project

remuneration (up to 10%) and/or partially guaranteed borrowed funds (up to 50%). A total of 103 projects were supported.

- **Complementary policies to support industrial energy efficiency.** No information is available.
- **Energy utility involvement in promoting energy efficiency.** Electricity and heat prices are currently mostly regulated and do not cover the full cost of investments. Increasing investments in the energy sector and making energy efficiency feasible will require that market incentives be delicately balanced with state steerage. The most important challenge in transitioning to market pricing is the potential impact of any market changes on end-user pricing (http://kazenergy.com/images/NationalReport15_English.pdf).

Electricity

In the 2009-15 period, the Cap Rate Programme – a tariff in exchange for investments – effected the required development of the electricity supply system. With implementation of the programme, about 3 GW of additional installed capacity was launched and 5 GW of existing electrical facilities were modernised. The implementation of cap rates had a positive impact on the work of the large electricity generation companies SevKazEnergo JSC, Atyrau CHPP JSC, Astana-Energy JSC, Stepnogorsk CHPP LLP, Pavlodarenergo JSC, AES Ust-Kamenogorsk CHPP JSC and GRES-2 of Kazakhmys Energy LLP (http://www.korem.kz/rus/o_kompanii/godovye_otchety/). Power plants reduced their marginal costs after former President N. Nazarbayev at the Security Council in November 2018 instructed them to reduce electricity tariffs. However, less than a year later, the Ministry of Energy allowed most power plants to raise their prices to cover rising transport, fuel, renewable energy subsidy and other costs (https://inbusiness.kz/ru/news/ministerstvo-energetiki-povysilo-predelnye-tarify-dlya-bolee-30-elektrostancij) by approving new cap rates for electricity for a group of energy-producing organisations (https://www.zakon.kz/4988180-izmeneny-predelnye-tarify-na.html). In April 2020, the JSC Central Asian Electric Power Corporation's First Deputy D. Turganov announced that the approved cap rates are considerably below the actual cost of electricity production. Turganov also declared that the approved capacity tariff does not cover the costs of energy enterprise modernisation and reconstruction (https://www.zakon.kz/5018396-tma-v-kontse-tonnelya-naskolko-serezny.html).

Renewable energy

The Green Economy Concept, targeting 50% alternative and renewable energy in the energy mix by 2050, and the Action Plan for the Development of

Alternative and Renewable Energy for 2013-20 were adopted in 2013. The action plan envisages the launch of 106 renewable energy facilities with a total installed capacity of 3 054.6 MW: 34 wind farms (1 787 MW), 28 solar power facilities (713.5 MW), 41 small HPPs (539 MW) and 3 biofuel power plants (15.05 MW) (https://greenkaz.org/images/for_news/pdf/npa/koncepciya-po-perehodu.pdf).

In 2019, 21 renewable energy facilities were commissioned, bringing the total number to 90, with an overall capacity of 1 050 MW. Renewable energy sources were used to generate 2.4 billion kWh of electricity in 2019, a 77.8% increase from 2018. The share of renewable energy in total electricity production is therefore 2.3% (https://forbes.kz/news/2020/02/25/newsid_219828).

Another 18 renewable energy facilities with a total capacity of 605.5 MW are planned for 2020, with renewables-based generation expected to reach 3 billion kWh (https://forbes.kz/news/2020/02/25/newsid_219828).

Regional markets and interconnections

Electricity

Interregional electricity transmission in Kazakhstan in 2015 was 37.89 terawatt hours (TWh), including 10% transit flows between Russia and Kazakhstan.

Historically, Kazakhstan has imported power from Kyrgyzstan's HPPs, mostly during the country's power-rich spring, but in 2015 electricity was exported and imported between Kazakhstan and Kyrgyzstan for irrigation needs only; total electricity purchased and sold was about 0.25 TWh. No unscheduled electricity was supplied from Kazakhstan to Uzbekistan in 2015, and import flows from Russia to Kazakhstan amounted to 1.5 TWh (7.3% lower than in 2014), whereas export flows to Russia were 1.03 TWh (67% less than in 2014) (www.kegoc.kz/1.1.%20KEGOC%20ANNUAL%20REPORT.pdf).

The concept for a single electricity market was approved by the Supreme Eurasian Economic Council in May 2015. To provide consumers the freedom to choose a power supplier, Russia, Kazakhstan, Armenia and Belarus have agreed on conditions for forming spot markets and a common electric power trading platform on the basis of bilateral contracts (http://www.pravo.by/document/?guid=3871&p0=F91500078).

Gas

Kazakhstan's gas transmission infrastructure consists of the following pipelines:

- Central Asia-Centre: capacity 60.2 bcm/y; length 3 962 km; operator Intergas Central Asia JSC
- Bukhara-Ural: capacity 8 bcm/y; length 1 576 km; operator Intergas Central Asia JSC
- Orenburg-Novopskov: capacity 14.6 bcm/y; length 382 km; operator Intergas Central Asia JSC
- Kazakhstan-China (A and B lines): capacity 30 bcm/y; length 3 909 km; operator Asian Gas Pipeline LLP
- Zhanaozen-Aktau: capacity 2.8 bcm/y; length 432 km; operator KTG-Aimak JSC
- Beineu-Bozoi-Shymkent: capacity 13 bcm/y (as of 2019); length 1 454 km; joint venture between KMG subsidiary KazTransGaz and CNPC subsidiary Trans-Asia Gas Pipeline
- Bukhara gas-bearing area-Tashkent-Bishkek-Almaty: capacity 5.8 bcm/y; length 1 597 km; operator Intergas Central Asia JSC.

These gas pipelines are used for the international transit of Turkmen and Uzbek gas through Kazakhstan towards Russia and China. Total international gas transited through Kazakhstan in 2014 was 78.6 bcm: 49.3 bcm of Russian gas; 25.6 bcm of Turkmen gas; and 3.7 bcm of Uzbek gas (https://www.kaztransgas.kz/index.php/ru/32-o-kompanii/494-transportirovka-i-marketing-gaza).

Oil

Oil exports are critical to Kazakhstan's economy. The main challenge of oil production is the long distances involved in moving crude oil to markets, leading to high transportation costs and export routes that involve transit countries (http://www.kazenergy.com/images/NationalReport15_English.pdf). The main operative oil export routes are the Atyrau-Samara pipeline; the Caspian Pipeline Consortium; the Atassu-Alashankou pipeline; and the Aktau sea terminal. The Caspian Pipeline Consortium transported the largest amount of Kazakh oil in 2018 (54.3 Mt). Exports through the Atyrau-Samara route totalled 8.8 Mt to the Ust-Luga terminal on the Baltic Sea and 6.9 Mt to the Novorossiysk port on the Black Sea. Only 1.4 Mt was exported via the Kazakhstan-China pipeline in 2018 (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf), but over 10.9 Mt went through the line in 2019 (https://oilcapital.ru/news/export/21-01-2020/pochti-11-mln-tonn-nefti-poluchil-kitay-iz-kazahstana-v-2019-godu). In January 2020 Kazakhstan had to suspend

oil exports to China due to poor fuel quality resulting from an excess of organochlorine compounds (https://ru.sputniknews.kz/economy/20200128/12664743/eksport-kazakhstan-neft-china-minenergo.html). Historically, most of Kazakhstan's crude oil exports have been to Mediterranean countries (79% in 2003 and 73% in 2005), but since 2005 there has been significant growth in exports to non-Mediterranean European countries (i.e. north-western Europe) and especially to China (http://www.kazenergy.com/images/NationalReport15_English.pdf).

Chapter 3. Sustainable development

Renewable energy

Small hydro

In 2019, the total installed capacity of small hydro was 224.6 MW and 1 105.3 million kWh of electricity was generated (https://www.gov.kz/memleket/entities/energo/documents/details/12625?lang=ru).

Solar

According to KOREM's report for 2018, electricity generation from solar power plants (SPPs) was 137.9 million kWh in 2018, which is 53.6% higher than the 89.9 million kWh in 2017 (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf). Solar generation capacity is provided by the Kapshagay SPP (2 MW) in the Almaty Region; Burnoye Solar-1 and Otar in the Zhambyl Region; SKZ-U LLP SPP in the Kyzylorda Region; and the Ochistnoy and Akbay SPPs of Aksu-Energo LLP in the South Kazakhstan Region (https://www.korem.kz/details/ndownload.php?fn=5079&lang=rus).

Wind

Kazakhstan's climatic conditions are favourable for wind power generation: 50% of Kazakhstan has average wind speeds of 4 metres per second (m/sec) at a height of 30 m. In 2018, generation from wind power plants was 400.5 million kWh, which was an 18.3% increase from 2017 (https://www.korem.kz/eng/about/godovye_otchety/). The largest wind power plants (Yereimentau-1 [45 MW] and Korday [19.6 MW]) are situated in the Akmola and Zhambyl regions. Small wind power plants (3.5 MW and 2 MW) began operating in the North Kazakhstan Region in 2013 (http://www.korem.kz/rus/o_kompanii/godovye_otchety/).

Geothermal

Kazakhstan possesses considerable mid- and low-temperature thermal water resources. Total thermal water resources are estimated at 520 megawatts thermal (MW_{th}) (free-flow operation) or 4 300 MW_{th} (pumped). Proven resources from the Cretaceous formations in southern and south-west Kazakhstan (Panfilov field) for electricity production are 12 MW_{th}. The main thermal water areas are located near the cities of Shymkent, Almaty and Kyzylorda, and on the Caspian Sea coast (http://www.energypartner.kz).

Biomass

Only 4% of Kazakhstan's overall territory (over 10 million hectares) is occupied by forests, with 4.7 million ha covered with saxaul (Haloxylon). The energy potential of timber waste is more than 200 kilotonnes of oil equivalent (ktoe), that of animal waste is 52 ktoe, and electricity generation potential from agricultural residue is estimated at 87 gigawatt hours (GWh) per year (http://www.energypartner.kz). In addition, the Biokhim wheat-based ethanol plant in northern Kazakhstan was to be brought back into operation in 2020 (https://inbusiness.kz/ru/last/zavod-biohim-perenes-sroki-zapuska-linii-po-proizvodstvu-bioetanola).

There is potential for biomass development in large farms and agricultural enterprises with animal husbandry or crop cultivation. The main waste residues in such farms include manure, crop residues and slaughtering residues. Kazakhstan has the following potential estimated volumes of available waste residues: 1.5 Mt of manure (dry), 0.1 Mt of slaughtering residues (wet), and 5.1 Mt of crop residues (dry) (https://www.ebrd.com/cs/Satellite?c=Content&cid=1395284589614&pagename=EBRD%2FContent%2FDownloadDocument). In cities, municipal solid waste separation could produce biological waste for energy use, with an available 5.4 Mt of waste, of which the amount of bio waste is 2.0 Mt (37%) (https://www.ebrd.com/cs/Satellite?c=Content&cid=1395284589614&pagename=EBRD%2FContent%2FDownloadDocument).

Waste

According to the Ministry of Ecology, Geology and Natural Resources, of all the industrial waste produced in 2016, 26.8% was processed and utilised; 30.9% was used in 2017 and 32.2% in 2018. The share of municipal solid waste (MSW)

recycled and used amounted to 11.5% in 2018, 9% in 2017 and 2.6% in 2016 (https://www.gov.kz/memleket/entities/ecogeo/documents/details/5522?lang=ru).

Kazakhstan produces 5-6 Mt of MSW annually; it is sorted and processed at factories in Nur-Sultan, Shymkent and Zhanaozen, as well as by various SMEs. In fact, more than 130 enterprises process recycled materials in the country, producing more than 20 types of products: plastic, metal, wood, glass, paper, crumb rubber and rubber products; biogas; fertilisers; and pyrolysis fuel. Kazakhstan had 3 521 landfills at the end of 2018, of which only 17.6% were officially legal. Landfills negatively affect the environment, particularly the quality of groundwater, soil cover and atmospheric air, and are a source of infection, rodents, and disease vectors. In 2019, authorities banned the disposal of plastic, paper and glass at landfills without prior sorting (https://rus.azattyq.org/a/kazakhstan-problemy-utilizatsii-i-pererabotki-otkhodov-v-kazakhstane/29741211.html).

Construction of the GreenRecycle LLP waste sorting complex in Almaty was completed in 2018. The plant has a capacity of 550 kt, with production of 50 kt of secondary raw materials planned (31% polyethylene terephthalate [PET], 24% cardboard, 8% cellophane, 29% glass, 7% plastic and 7% metal) (https://kursiv.kz/news/vlast-i-biznes/2018-12/nazarbaev-poruchil-otkryt-musoropererabatyvayuschie-zavody-v-astane-i?page=89). The Green Economy Concept aims to have 40% of all waste recycled by 2030 and 50% by 2050 (http://gbpp.org/wp-content/uploads/2014/04/Green_Concept_En.pdf Accessed 21.02.2017).

A programme of expanded producer and importer liability took effect 1 January 2016, requiring importers and goods manufacturers to pay recycling fees. An approved list of products (goods) is subject to extended producer (importer) obligations, and the ROP Operator LLP oversees the recycling programme, collecting payments and administering collected funds. The ROP Operator also launched a compensation programme for disposing of old vehicles (https://www.kursiv.kz/examination/blog/kto-budet-platit-za-utilizaciu-othodov-v-kazahstane/ and https://recycle.kz/).

The separate collection of solid waste is gradually being introduced in Kazakhstan. With the financial support of the ROP Operator, 12 196 containers for separate collection were installed in 10 regions and in the city of Nur-Sultan; 147 collection points were introduced in 8 regions; and 28 specialised vehicles were purchased in 2018-19. In 11 regions, 2 321 containers for mercury-containing lamps and chemical power sources were installed

(https://www.inform.kz/ru/naskol-ko-effektivno-rabotaet-koncepciya-rop-v-kazahstane_a3620805). In 2017, a plant for the utilisation of obsolete cars was launched in the Karaganda region; it has accepted 121 477 vehicles for recycling and processed 102 000 old cars (https://tengrinews.kz/kazakhstan_news/12-milliardov-tenge-vyidelil-operator-rop-sbor-pererabotku-385762/).

Energy efficiency

In terms of energy intensity of GDP (the energy intensity of primary energy in megajoules [MJ] per 2011 USD at purchasing power parity [PPP] of GDP), Kazakhstan was 31st in the world in 2015 according to the World Bank (https://data.worldbank.org/indicator/EG.EGY.PRIM.PP.KD?most_recent_value_desc=true) because of its severe continental climate, long and cold winters, the prevalence of energy-intensive sectors in its economy, its large territory and extensive transport infrastructure (oil and gas pipelines, electricity transmission lines and water ducts). Due to the availability of affordable coal and relatively low regulated energy tariffs (for heat, gas and electricity), the attractiveness of investing in energy-saving projects remains low (http://kazenergy.com/images/NationalReport15_English.pdf).

Some progress has been made, however, with the Law on Energy Conservation and Energy Efficiency, which introduced:

- A procedure for conducting energy audits to assess energy efficiency and to implement energy supply management systems at major industrial enterprises and other buildings.
- Facilities for training energy auditors and managers as well as for conducting research activities.
- Energy service contracts.
- A ban on incandescent lighting fixtures and on sales of electrical products without energy efficiency grade indication.
- Differentiated payments for heat consumption depending on whether heat metering is installed (http://kazenergy.com/images/NationalReport15_English.pdf).
- Compliance with energy consumption standards and normative capacity coefficient values in power grid networks.
- Reviews of new construction projects for energy efficiency and energy savings (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_en.pdf).

There is significant potential for energy efficiency in buildings in Kazakhstan. Average residential energy consumption (270 kWh/m²) exceeds that of the

European Union (100 kWh/m² to 120 kWh/m²) and Russia (210 kWh/m²). For new residential construction, the Law on Energy Saving and Energy Efficiency specifies the use of modern energy-saving materials and the installation of automated heating systems and utility metering devices. For existing residential structures, the Law requires that such materials, heating systems and devices be installed during capital repairs or reconstruction (http://kazenergy.com/images/NationalReport15_English.pdf).

Fuel switching

Under the Green Economy Concept, investments are needed for the creation of gas infrastructure in the North, East and South regions to enable co-generation plants to switch from coal to gas in all large cities. This would result in lower local emissions and better air quality and would ensure flexible backup capacity for intermittent renewable energy sources. Electricity generated by coal plants would remain at the current level until 2030, but gas in power generation would double to 8 bcm/y by 2030, from 4 bcm/y in 2012 (http://gbpp.org/wp-content/uploads/2014/04/Green_Concept_En.pdf).

In 2014, the government approved a General Scheme for 2015-30 to delineate the country's access to gas. A realistic scenario involves expanding distribution pipelines in regions that already have access to gas and constructing new branch pipelines to regions located near main pipelines (in western and southern Kazakhstan). More than 3 million citizens have been provided with piped gas in the past seven years (as of 2020), extending gas access to more than 9 million residents (a rise from 30% in 2013 to 51% in 2019) (https://www.kaztransgas.kz/images/01_reports/annual-2019-rus.pdf).

Since 2016, the Beineu-Bozoi-Shymkent pipeline has been moving gas from the country's western gas production regions to southern areas. Construction of the Saryarka gas pipeline was started in November 2018 to provide gas to Nur-Sultan as well as to central and northern Kazakhstan by 2023. In October 2019 the first stage of construction from Kyzylorda to Nur-Sultan was completed (https://ru.sputniknews.kz/economy/20191129/12161758/Vtoraya-ochered-gazoprovoda-Saryarka-otsenivaetsya-v-124-milliona-dollarov.html). In only a short time, 1 061.3 km of pipeline, five powerful automated gas distribution stations and a gas measuring station had been built (https://informburo.kz/novosti/gazoprovod-saryarka-vveli-v-ekspluataciyu-

100415.html). The pipeline's capacity of 2.2 bcm per year is expected to provide gas to 171 settlements and 2.7 million people in the Karaganda and Akmola regions.

Also in 2016, Gazprom Export and LLP Global Gas Regazification, part of the Global Gas Group Company, signed the first-ever contract to supply small-tonnage LNG by road from Russia to Kazakhstan. In 2017, 320 kt of LNG was delivered from Yeaketerinburg to Nur-Sultan. In February 2017, the first LNG regasification complex (Turan) was launched in Nur-Sultan within the framework of the Astana LNG 2020 project, with the first consumer being Nazarbayev University (https://globalgas.kz/ru/company/press-center/news/otkrytie-krspg-turan/). Gazprom Transgaz Yekaterinburg LLC delivered 7.7 kt of LNG to Kazakhstan in 2018 and more than 9 kt in 2019. Thus, in 2019 the company increased Kazakhstan's LNG supplies by 16.9% (https://inbusiness.kz/ru/last/gazprom-v-2019-godu-uvelichil-postavki-spg-v-kazahstan-na-17).

Environmental protection

Kazakhstan suffers from land degradation, desertification and water scarcity as a result of past military nuclear testing programmes and industrial and mining activities. As similar conditions prevail throughout the Central Asia region, in 2010 Kazakhstan established the Green Bridge Partnership Programme for sustainable development within the region and beyond. In Central Asia, the programme addresses issues related to energy and water linkages.

In addition, Kazakhstan has ratified more than 20 international environmental treaties. They provide the basis for its national environmental regulatory framework, which includes national laws, presidential decrees and government resolutions.

The Ministry of Ecology, Geology and Natural Resources administers environmental protection in Kazakhstan, and the 2007 Environmental Code is the country's basic legislative framework for any activity requiring environmental protection (http://adilet.zan.kz/). An environmental permit is required for any emissions of pollutants into the environment, for wastewater discharges and waste disposal in the environment, and for open storage of sulphur. State authorities apply fines for environmental offences, or suspend or cancel the environmental permit (https://iclg.com/practice-areas/environment-and-climate-change-law/environment-and-climate-change-law-2016/kazakhstan).

However, some important environmental concerns are the absence of coal-fired power plant ash and slag waste management systems; inadequate ash capture in coal-fired power station stacks; and air and water pollution at mineral resource extraction and processing sites (http://kazenergy.com/images/NationalReport15_English.pdf). Current air pollutant emissions standards in Kazakhstan fall well behind those of the European Union, and most of Kazakhstan's cities suffer from poor air quality (https://www.annalsofglobalhealth.org/articles/10.5334/aogh.2535/). Extremely high risks of developing the chronic effects of heavy-metal exposure were detected in Ust-Kamenogorsk, Shymkent, Almaty, Taraz and Balkhash. According to the Green Economy Concept, more stringent standards for emissions of particulate matter, sulphur dioxide (SO_2) and nitrogen oxide (NO_x) have to be adopted (http://gbpp.org/wp-content/uploads/2014/04/Green_Concept_En.pdf).

Kazakhstan's current emissions standards are less stringent than those of OECD countries and China. Permissible emissions of solid particles by coal-fired power plants in Kazakhstan are several times above EU limits. Kazenergy (2019) therefore stresses the introduction of high-performance double-blow electrostatic precipitators, combustion optimisation systems and sulphur oxide control systems to reduce emissions in priority areas (https://www.kazenergy.com/upload/document/energy-report/National Report19_en.pdf).

Climate change

Kazakhstan submitted its Intended Nationally Determined Contribution (INDC) to the 21st Conference of the Parties (COP21) in Paris in September 2015, with a pledge to reduce greenhouse gas (GHG) emissions by 15-25% from the 1990 level by 31 December 2030. It ratified the Paris Agreement in December 2016, and the target of 15% including emissions from land use, land use change and forestry (LULUCF) is unconditional, while the 25% target (also including LULUCF) is contingent on access to additional international investments, low-carbon technology transfer mechanisms, green climate funds and flexible mechanisms for countries with economies in transition. The unconditional target is equivalent to a 13% increase in emissions in 2020 compared with 2012, and 1% increases in 2025 and 2030 (http://climateactiontracker.org/countries/kazakhstan.html).

The latest national inventory indicates that Kazakhstan's GHG emissions (excluding LULUCF) in 2017 were 353.2 million tonnes of carbon dioxide

equivalent ($MtCO_2$-eq), 8.5% lower than in base year 1990; GHG emissions from the energy sector accounted for 82% of total emissions. GHG emissions from fuel combustion in Kazakhstan can be clearly divided into two periods: a gradual decrease from 1990 to early 1999, and slower growth with small fluctuations since 2000 (http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php).

Kazakhstan approved its emissions trading scheme (ETS) in 2011. In Phase I (2013), allowance surrender obligations were imposed on 178 companies and the cap was set at 147 $MtCO_2$ (plus a reserve of 20.6 $MtCO_2$), equivalent to 2010 levels. Phase II (2014-15) covered 166 companies and the cap was set at 155.4 $MtCO_2$ for 2014 and 153 $MtCO_2$ for 2015 – i.e. reduction targets of 0% in 2014 and 1.5% in 2015 compared with the average CO_2 emissions of capped entities in 2011-12. The Phase III (2016-20) cap is set at 746.5 $MtCO_2$ (plus a reserve of 21.9 $MtCO_2$) and 140 companies are affected.

The first two phases included free allowances, with the possibility of introducing auctioning in Phase III. The allocation of allowances was based on an historical approach and in 2016 it was proposed that allowances be distributed based on benchmarking. In early 2016, emissions trading was suspended until 2018 to adjust and improve the distribution system of quotas. In April 2018 Vice-Minister of Energy Mr Zhaksaliyev announced that 76 enterprises had chosen the historical approach and 149 had chosen benchmarking. The historical method for allocating quotas is based on the average value of emissions for the previous time period, while benchmarking compares the intensity of emissions relative to the output. The national quota allocation plan adopted in January 2018 sets a total emissions cap for 129 companies for 2018-20 (https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems%5B%5D=46). Kazenergy (2019) claims that benchmarks are designed to give more free allowances to coal-fired than gas-fired plants because the emissions intensity of coal-based electricity was 0.985 tCO_2/MWh in 2018, while it was only 0.621 tCO_2/MWh for electricity generated from other fuels (fuel oil and natural gas). Such a policy therefore reduces the incentive to switch from coal to gas for power generation (https://www.kazenergy.com/upload/document/energy-report/NationalReport19_ru.pdf).

Recent modelling indicates that Kazakhstan's -15% INDC target is rather ambitious and would require the expedited construction of pipelines to regions lacking access to gas. The success of the ETS and the measures prescribed by Green Economy Concept are not sufficient to reach this goal, so additional

efforts are needed in the non-ETS transport, agriculture, waste and residential sectors (https://www.ucc.ie/en/media/research/iew2016/BakytzhanSuleimenov.pdf).

Technology research, development and deployment

In 2015, the National Agency for Technological Development (NATD) distributed KZT 1.6 billion (almost USD 100 million at the 2015 exchange rate) to support 51 projects. The government's priorities include the development of: information and communications technology (ICT) for the telecommunications sector; renewable energy resources; new materials; pharmaceutical products; and, last but not least, new oil and gas sector technologies and innovations (https://www.cacianalyst.org/publications/analytical-articles/item/13397-technoparks-in-kazakhstan-will-they-help-develop-the-innovation-sector?.html).

Financial support for development in science and research in Kazakhstan comes mainly from the national budget through several types of funding: basic; programme-targeted; and grants. In 2018, domestic research and development (R&D) expenses amounted to KZT 72.2 billion, or 0.12% of Kazakhstan's GDP. This share has been in continuous decline for the past five years (https://kursiv.kz/news/ekonomika/2019-05/uvelichit-raskhody-na-nauchno-issledovatelskie-raboty-predlagayut-deputaty). However, at a government meeting chaired by Prime Minister Askar Mamin in December 2019, it was decided that education and science expenditures should increase to 7% of Kazakhstan's GDP by 2025 (https://primeminister.kz/ru/news/rashody-na-obrazovanie-i-nauku-k-2025-godu-vyrastut-do-7-ot-vvp-kazahstana).

The Technology Commercialization Project, an initiative of the World Bank Group's Trade & Competitiveness Global Practice and the Government of Kazakhstan, provided grants to scientists between 2008 and 2015. The project initiated 65 new science-based start-ups in agriculture, gas, oil, medicine and other areas (http://www.worldbank.org/en/results/2016/12/20/getting-kazakhstans-technology-out-of-the-lab-and-into-global-markets).

Also in co-operation with the World Bank, since 2014 the Ministry of Education and Science has been implementing the Fostering Productive Innovation Project. The project has five components: developing a knowledge base for innovation; forming innovation consortiums; consolidating the technology commercialisation cycle; strengthening co-ordination of the national innovation system to enhance

the capacity of existing institutional structures; and implementing support projects (http://projects.worldbank.org/P150402?lang=en).

In 2014, the government introduced a special Law on the Innovation Cluster Innovative Technologies Park to define the special status of the Innovative Technologies Park (ITP) free economic zone, and the peculiarities of attracting foreign labour by the autonomous cluster fund of the ITP. It also aims to provide a legislative framework for the free economic zone's individual management system (https://www.cacianalyst.org/publications/analytical-articles/item/13397-technoparks-in-kazakhstan-will-they-help-develop-the-innovation-sector?.html).

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