Energy Transition in Kazakhstan – Back to the Sustainable Future

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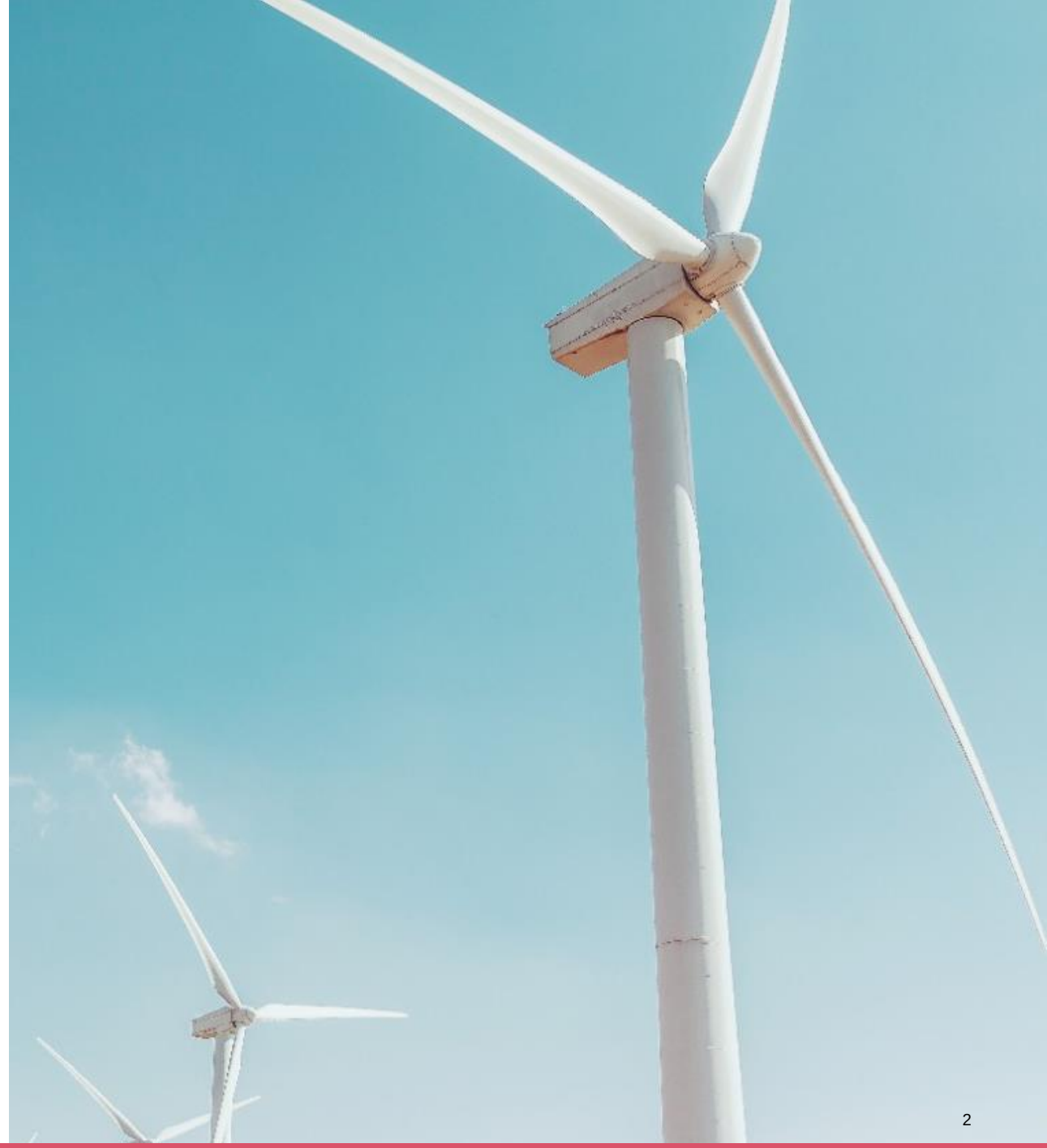
Important note

PwC Kazakhstan presents the results of the study “Energy transition in Kazakhstan – Back to the Sustainable future” as of 30 June 2022. The study includes coverage of trends in the energy sector, data on renewable energy facilities, including location and capacity, as well as opportunities for further development of renewable energy.

In the report you will also find the results from our the survey of Kazakh experts in the renewable energy sector: they include renewable energy producers, business associations, independent experts, analysts and consultants.

Overall our report reflects:

- The state of the energy market at 30 June 2022
- The views of those surveyed including on the development of the energy and renewable energy market
- Anticipated future developments including an energy crisis in the near future
- Recommendations on actions needed to address the imminent crisis



Natalya Lim
Partner, Advisory Service
PwC Eurasia Leader

Introduction

Environmental catastrophe is not a cliche. We are at the edge or possibly have stepped over it, where the question of the survival of not only humanity, but all living things is uncertain. We are the drivers of climate change and air pollution, as every day many of us consume without considering the consequences.

Very importantly, however, Europe is resolute in relation to the transformation of the energy sector, on which almost all life and production depend. This provides us with some guidance.

As part of last year's study, global and local trends in investment stimulating the energy transition (especially the active development of renewable energy) were noted: Europe was the first to develop and introduce regulation, including policies for the complete abandonment of coal. However, recent developments in geopolitics have presented the world with a dilemma that has shaken the decarbonization agenda and its timely execution.

The experience of Europe in 2022 has shown that energy security underpins the economy and the well-being of society. We see that energy transition is not the enemy of energy security. RES, clean technologies and energy efficient consumption – they are elements of a systematic approach to energy security.

The EU continues to pursue its decarbonization plans by raising the price of emissions through the EU ETS, which in turn will increase its effect on the final price of fuel and electricity.

Kazakhstan needs to consider a number of questions. What is the main challenge for our country so that, like the EU, Kazakhstan can continue the decarbonization agenda for the benefit of society and future generations? Is our country ready for the liberalization of the electricity market? Are we ready to give an opportunity and guarantees to investors seeking to invest in the development of renewable energy infrastructure and smart grid technologies for the transmission of electricity? The answer must be yes to all these questions.

The energy transition is a complex but achievable transformation that requires more than just investment. Most importantly, it is predicated on conditions and a coordinated systematic approach between all participants, where the state plays a decisive role thinking of the long term while achieving short term goals.

As such, the basis for the development of the energy industry is a comprehensive strategy that will determine the long-term vision for the sector.

Content

Overview, objectives and conclusions of the study

What we analyzed

This study was prepared by PwC Kazakhstan as part of the annual Energy Reviews. It analyzes world electricity markets including Kazakhstan, as well as the markets for fossil fuels.

The main topics of research are the energy crisis exacerbated by various geopolitical upheavals, the role of coal in the energy transition and the current state of the renewable energy market. Opportunities for further development of renewable energy sources and clean technologies were identified.

The purpose of the study is to identify the challenges as well as prospects for the energy transition in Kazakhstan. We also consider the development of the electricity sector to help overcome current difficulties.

As part of the study, a survey of energy and economic experts was conducted. The results of the survey are aggregated and presented later in the study.

The energy crisis, which has deepened in recent years, has significantly affected the development of the energy markets. The ongoing global crisis has forced several countries to reopen coal-fired power plants and deposits. In parallel, the greening of the global economy continues to gain momentum: this transition will require significantly more investment and much stronger government support .

Kazakhstan continues to develop RES. In the first half of 2022, the share of renewable energy in the structure of electricity generation reached 4.24%: compared to the same period last year, the increase was 17%. At the same time, further increases in the level of renewable energy requires immediate economic, infrastructural and legislative reforms.

Data analysis approach and survey results (1/2)

What we analyzed

The study analyzed statistical data from open sources on world energy, as well as the Kazakh market. We looked at the role of coal in the energy balance, the development of renewable energy sources and the capacity of operated and commissioned facilities, all in regard to Kazakhstan.

More specific sources are mentioned below.

Overview of the global energy sector:

- Statistical energy overview by country for the period from 2000 to 2021 from the BP statistical platform;
- Report on GDP and GDP per capita data for the period from 2000 to 2022 from the World Bank statistical platform;
- Reports on investments in energy and clean technologies, on the gas market of the International Energy Agency;
- World Bank Carbon Price Status and Trends Report.

Overview of the role of coal in the energy sector of Kazakhstan:

- UNDP report on the analysis of the electricity and heat market to identify direct and indirect subsidies in Kazakhstan;
- Report of the International Energy Agency World Energy Outlook 2021;
- National energy report KAZENERGY 2021.

Overview of the renewable energy market in Kazakhstan:

- Reports on energy generation and capacity of stations by types of RES for the period from 2016 to 2022 on the website of the Ministry of Energy;
- Data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan;
- Reports of Samruk-Energy "Analysis of the electricity and coal market in Kazakhstan" for the period from 2016 to 2021.

Data analysis approach and survey results (2/2)

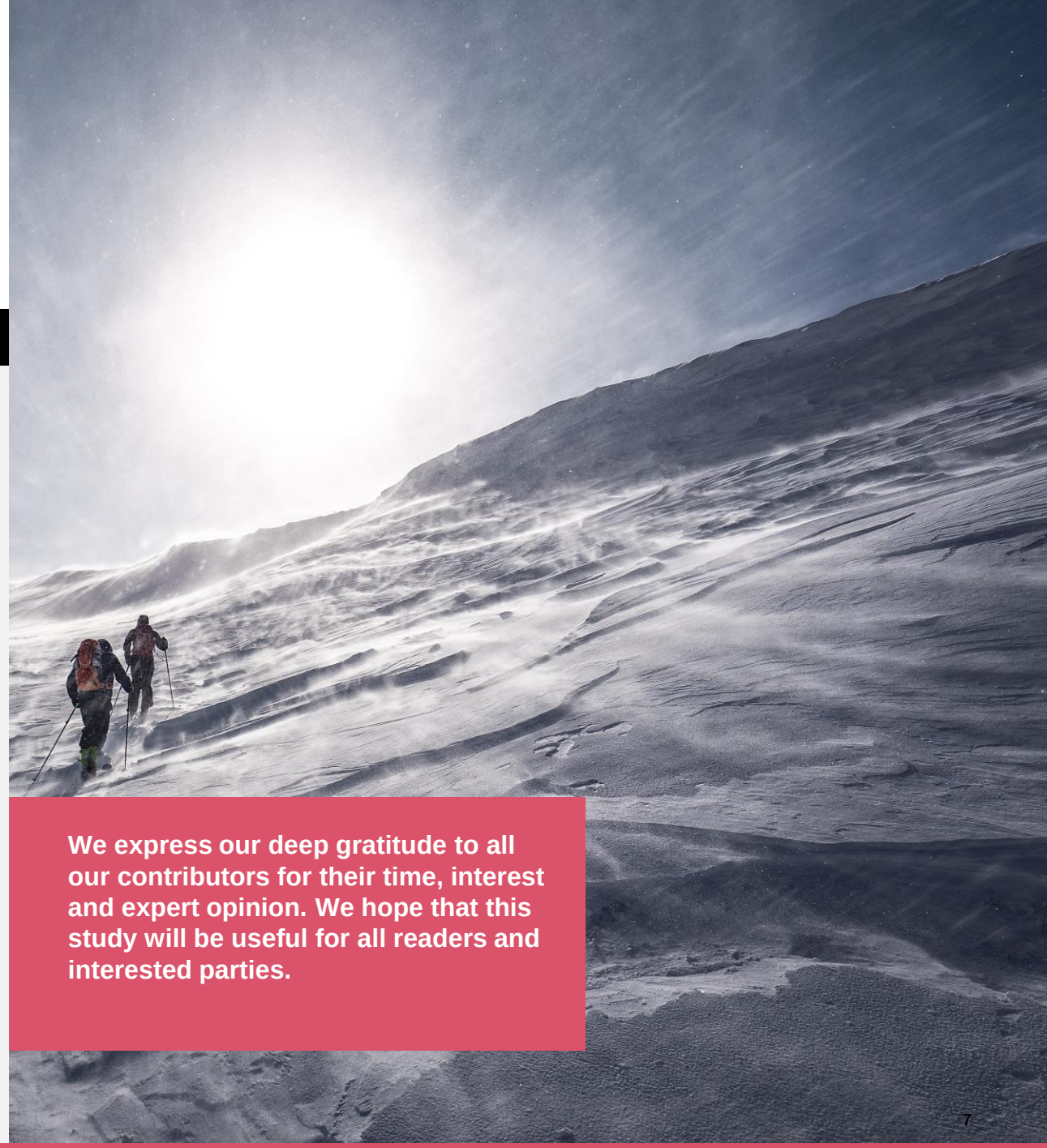
What we analyzed

Crucial input for our report, was a survey of market participants to obtain a more complete and balanced picture. Participants were representatives of the electricity and mining sectors, renewable energy sources and independent experts.

They were asked to share their views on the prospects and challenges of Kazakhstan's energy transition, as well as the further development of the electricity and renewable energy sector. The results are presented in an aggregated form. Individual comments from respondents were disclosed in our study with the permission of the respondents.

The survey was conducted between August and September 2022.
The results of this survey are presented later in the report.

Note that the opinion of the respondents may reflect their own position on certain issues, and not the position of the company / department where the respondents work. Also note that at the date of release of this study, information on the place of work and position of our respondents may not be relevant due to time lapse since the interview.



We express our deep gratitude to all our contributors for their time, interest and expert opinion. We hope that this study will be useful for all readers and interested parties.

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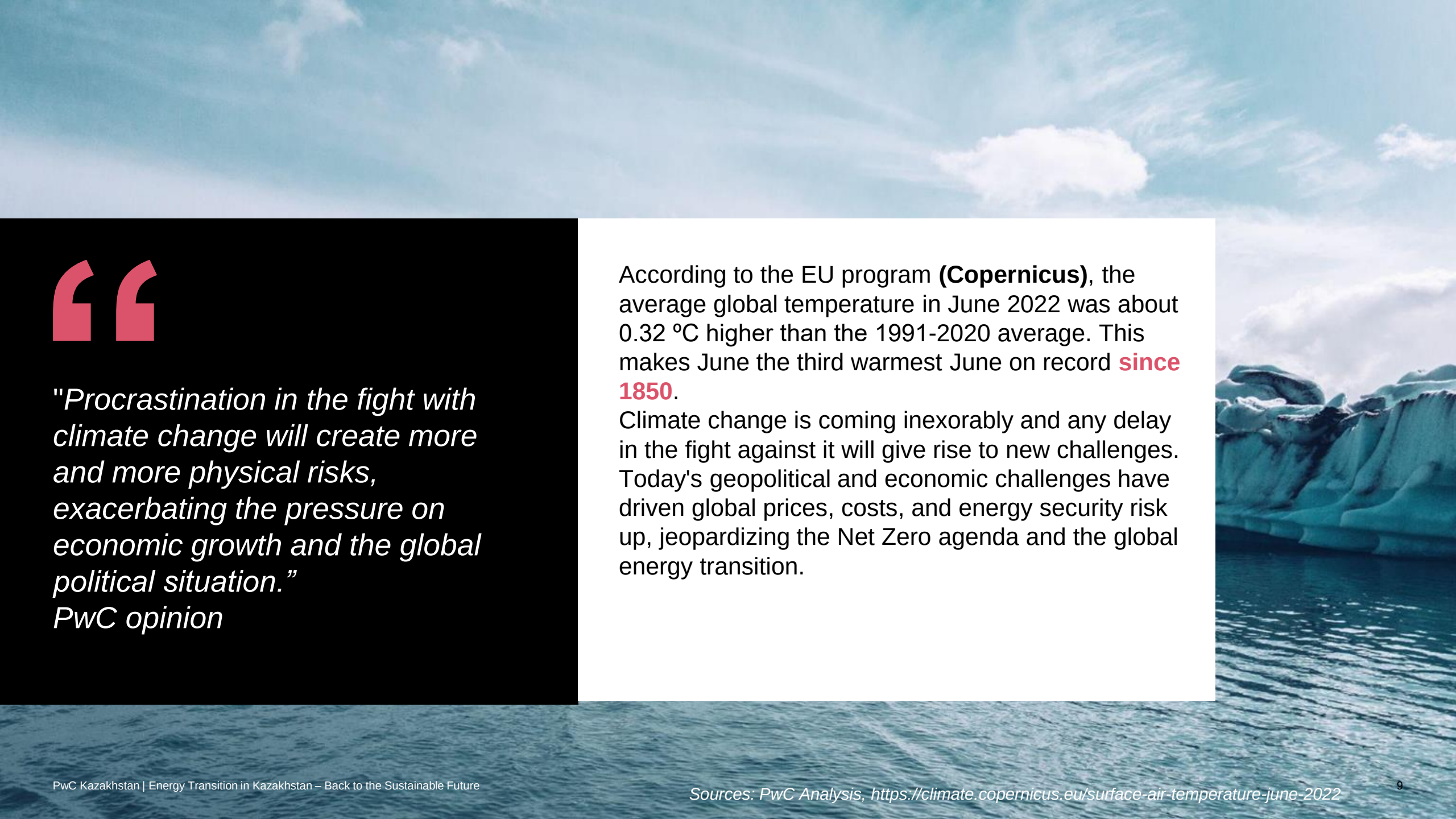
The global energy crisis and its impact on the energy sector



"*Procrastination in the fight with climate change will create more and more physical risks, exacerbating the pressure on economic growth and the global political situation.”*
PwC opinion

According to the EU program **(Copernicus)**, the average global temperature in June 2022 was about 0.32 ºC higher than the 1991-2020 average. This makes June the third warmest June on record **since 1850**.
Climate change is coming inexorably and any delay in the fight against it will give rise to new challenges. Today's geopolitical and economic challenges have driven global prices, costs, and energy security risk up, jeopardizing the Net Zero agenda and the global energy transition.

Sources: PwC Analysis, https://climate.copernicus.eu/surface-air-temperature-june-2022

New global challenges will adjust the pace and plans for the energy transition in many countries

However, these challenges may bring new opportunities – countries and corporations will try to move away from high dependence on Russia in value chains, which may push them to reorient themselves towards new energy efficient solutions and clean energy sources.

All this will undoubtedly require large investments, which, due to growing inflation, will not bring the previously expected significant increase in capacity. Rising inflation rates, in turn, are associated with rising hydrocarbon prices, supply chain disruption, rising electricity and fuel prices.

According to the IEA, after years of declining prices for components for solar and wind power, the cost has begun to rise again - an increase of 10 to 20% since 2020.

Thus, governments need to solve contradictory tasks: the cost of electricity is increasing under the pressure of rising energy prices and investments in the energy transition, while price surges must be contained to prevent a significant decrease in citizen's quality of life.

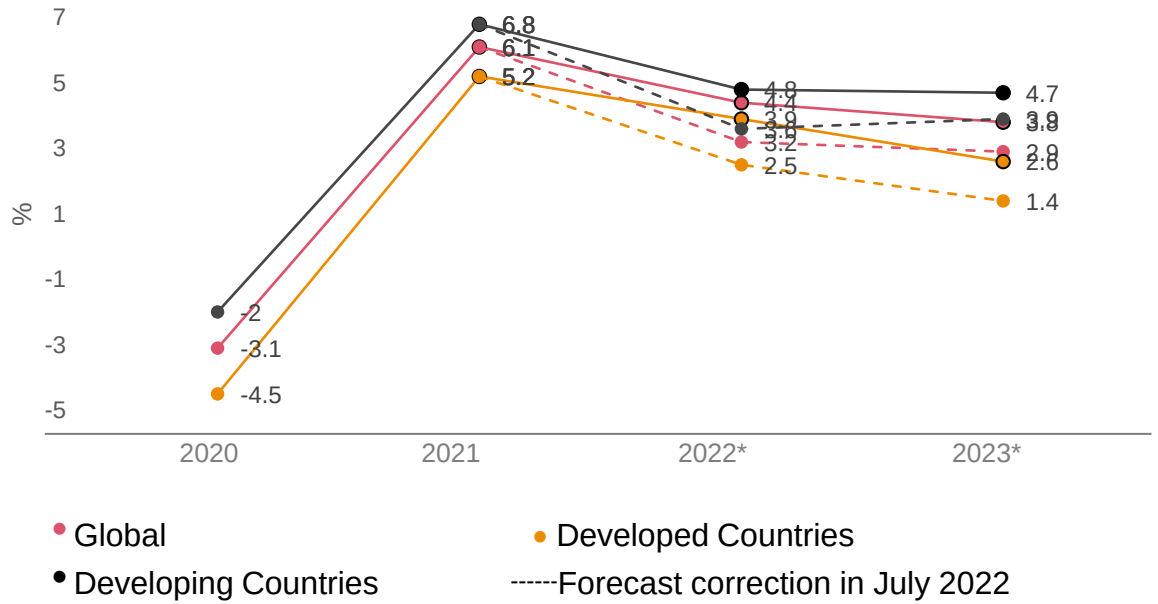
Source: PwC analysis, IEA

New global challenges have dramatically influenced economic growth forecasts

In 2021, the global economy, which began to recover from the shock caused by COVID-19, faced new challenges in early 2022, which led to a sharp increase in the global inflation rate.

The IMF, taking into account all the geopolitical events that have affected the energy sector of the world, has adjusted its baseline economic growth forecast towards a serious decline.

Annual rate of change in global GDP 2020-2021 and forecast for 2022-2023.

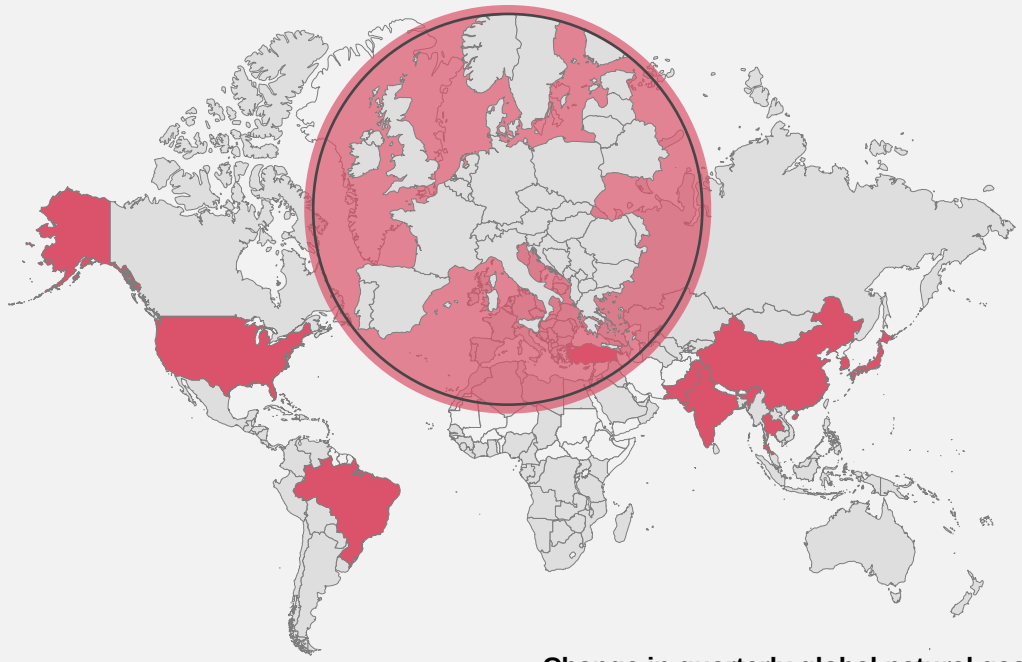


Sources: IMF, open sources
** IMF forecast*

The pandemic, geopolitical and climatic changes have led to an increase in the consumption of fossil fuels,...

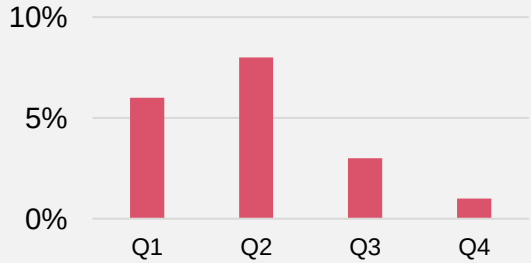
Global natural gas consumption in 2021 increased by 5.3% year-on-year, showing the third highest growth since 2000 (growth in 2010 - 7.8% and 2018 - 5.2%).

- A cold winter 2020-2021 in Asia and Europe led to an increase in gas consumption
- Abnormal cold weather in Texas (USA) contributed to an increase in gas consumption, which led to a reduction in shipments from the US to Asia and Europe
- Severe drought in Turkey, Brazil and California (USA) led to a sharp decline in hydro generation and the use of gas for energy production
- Pandemic-driven LNG capacity shortage led to a record peak in LNG spot rates in early 2021
- Abnormal weather conditions in Europe, Asia and the USA have led to a sharp increase in demand for air conditioning systems
- At the end of 2021 in Europe, the filling of hollows with gas reserves was only 55%, which aggravated the situation
- The decline in wind generation in Europe (the UK, Germany and the Netherlands) due to weather conditions led to an increase in the consumption of coal and gas in this region, the phasing out of nuclear energy in Germany also exacerbated the situation
- Trade disputes between China and Australia have forced China to reduce LNG imports from Australia and, as a result, increase coal consumption.



- Gas consumption slowed down significantly in the second half of 2021. The slowdown was caused by rising prices, which led to the abandonment of gas and a decrease in its consumption in the industrial sector

Change in quarterly global natural gas consumption in 2020-2021



Sources: IEA, European Union Institute for Security Studies, BP

… which led to a sharp increase in gas prices in 2021 and the start of an energy crisis

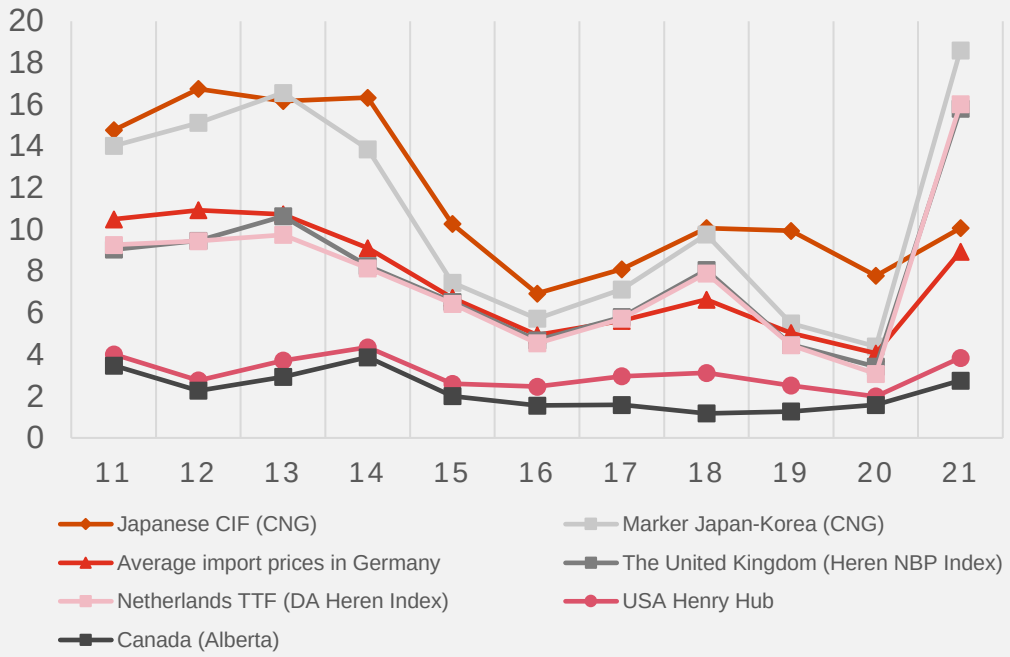
The rise in gas prices in 2021 reached historic highs in recent decades:

- In Europe, the TTF index rose five times from its 2020 low and hit a record annual average of $15.8/MBTU by the end of 2021.
- In the US, Henry Hub prices averaged $3.9/MBTU in 2021, the highest since 2014.
- In Asia, average annual gas prices increased more than 4 times - from 4.4 in 2020 to 18.6 USD/MBTU in 2021.
- In October 2021, the price of gas exceeded the level of oil prices - the daily price in the Dutch hub (European benchmark) reached 131 euros / MWh, the increase was caused by the approaching heating season and forecasts of a cold winter in Europe.
- Russia's refusal to increase gas supplies to Europe in 2021, despite the availability of spare transport capacity, has supported high spot rates in Asia and Europe.

The rise in gas prices contributes to the increase in electricity prices:

- In Europe, where gas-fired generation of electricity accounts for 22% of the total, wholesale electricity prices increased by about 7.5 times in 2021 compared to the average value of the previous ten-year period (2010-2020), which was one of the reasons for the increase in inflation in the EU.

Gas prices by benchmark LNG hubs and pipelines, 2011-2021 (USD/MBTU)



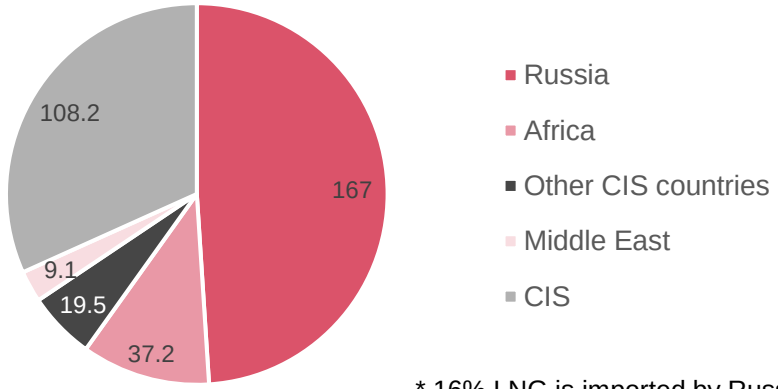
Source: IEA, European Union Institute for Security Studies, BP

Ongoing conflict in Ukraine exacerbates the energy crisis

The impositions of sanctions against Russia, including the European Union move to significantly reduce the consumption of Russian gas, led to the second wave of the energy crisis. Russia is by far the largest supplier of gas and coal to Europe.

In recent decades, Europe's dependence on Russian gas has steadily grown. As of 2021, Russian pipeline gas exports to Europe amounted to 167 bcm, equivalent to 33% of global pipeline gas trade.

Share of pipeline gas and LNG imports to Europe in 2021*, (bcm)



* 16% LNG is imported by Russia

In the first half of 2022, the supply of pipeline gas from Russia decreased by 30% compared to the same period last year, while maintaining such rates, imports of Russian pipeline gas will decrease by more than 45% (less than 80 billion cubic meters) by the end of the year.

The EU decision to phase out Russian gas is changing the European gas market and global market dynamics in general.

According to the IEA, from 2021 to 2025, Europe will increase LNG consumption by 51%, which will account for 60% of global LNG trade. Record high gas prices in Europe are attracting supplies from other regions, leading to increased supply tensions in other markets.

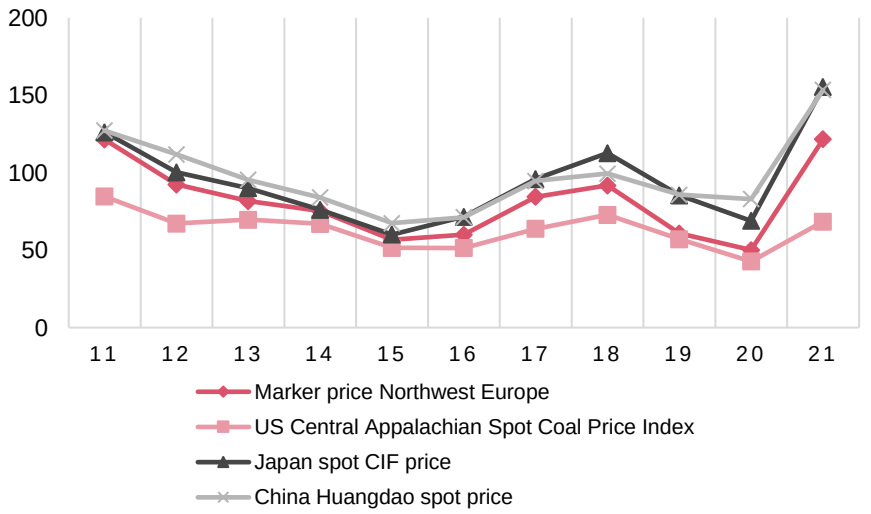
The rise in gas prices increases the price of electricity, which causes a decrease in production, up to the closure of factories in Europe. Some companies have switched to stop-and-go operation: industrial plants operate only under conditions of low electricity prices.

Source: IEA, BP, European Union Institute for Security Studies

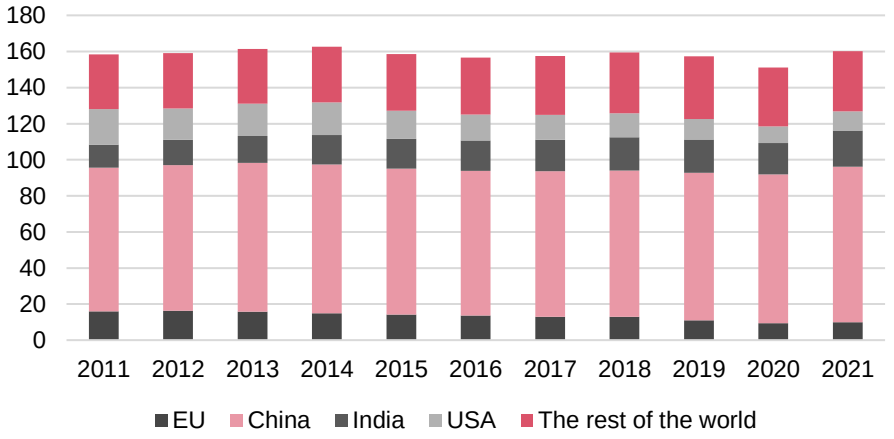
Increased gas prices have led to the use of coal as an alternative: coal prices also began to rise

- Rising gas prices, the recovery of the economy after the pandemic, the restart of production and new capacities of coal-fired generation led to an increase in demand for coal, with global coal consumption growing by 6.3%. Consumption in the European Union increased for the first time in the last 10 years – an increase of 13.2%.
- Despite a 6% increase in global coal production, China and India experienced a domestic shortage of coal. In 2021, China introduced operation of new coal plants with a capacity of 25.2 GW, which is 56% of the commissioned coal capacity in the world.
- Coal prices also hit their highs in the past decade, especially in the Chinese market, with a price of $153.55/t in 2021, the highest price in the Chinese market since 2001.

Coal prices, 2011-2021 (US$/ton)



Global coal consumption, 2011-2021 (exajoule)



Source: IEA, BP, World Bank

Reflecting the energy crisis, Europe temporarily switches to coal-fired electricity

In order to ensure energy security, reduce dependence on Russia and replenish gas reserves, a number of European countries are extending the life of coal-fired power plants and returning previously retired capacities.

Germany plans to launch mothballed coal plants, adding 10 GW of capacity in 2 years

Italy plans to temporarily bring two existing coal-fired power plants to full capacity in the event of a power shortage

Netherlands has removed the restriction on coal-fired electricity generation to save gas

Romania plans to temporarily restart idle coal-fired power plants

Greece postpones the closure of coal-fired power plants from 2023 to 2028

In **Austria**, a back-up gas-fired power plant will be converted to use coal in case of a possible emergency

In the **United Kingdom**, a coal-fired power plant opened in 1966 will run until March 2023. Other stations may also extend service

According to the World Bank, natural gas and coal prices are expected to decline moderately in 2023, although they will remain much higher than the average over the past five years. However, the conflict in Ukraine brings uncertainty to the coal and gas trading market. Fossil fuel prices are extremely sensitive to various external factors, as has been observed in recent years.

Source: IEA, World Bank, open sources

Significantly, the EU does not abandon plans for decarbonization.

85% of Europeans think that the EU should reduce its dependence on Russian gas and oil as soon as possible.

In response to the energy crisis and to address the issue of dependence on Russian energy carriers, the European Commission adopted the REPowerEU plan.

Earlier, the European Parliament approved the Green Deal package of measures, which includes ambitious plans to massively reduce greenhouse gas emissions, increase renewable energy and invest in cutting-edge research and innovation.

REP owerEU includes work in several directions, strengthening the previously set goals under the "Green Deal"

- **Energy saving.** The European Commission proposes to strengthen long-term measures to improve energy efficiency, including an increase from 9% to 13% of the mandatory energy efficiency target under the "Fit for 55" package.
- **Diversification of supplies and support of international partners.** Increase in LNG imports and pipeline gas supplies. Creation of infrastructure for LNG and its further use for hydrogen and other low-carbon gases.
- **Accelerating the deployment of renewable energy sources.** The target for the share of renewable energy sources in the generation structure has been increased from 40% to 45% by 2030 as part of the Fit for 55 package.
- **Reducing the consumption of fossil fuels in industry and transport.**

In addition, changes to the Emissions Trading System (EU ETS) to gradually reduce emissions allowances until they are eliminated by 2032 should result in reduced emissions and accelerated coal phasing out.

Source: Open sources

Carbon prices in the EU ETS have tripled, but have not influenced the price of electricity significantly to date

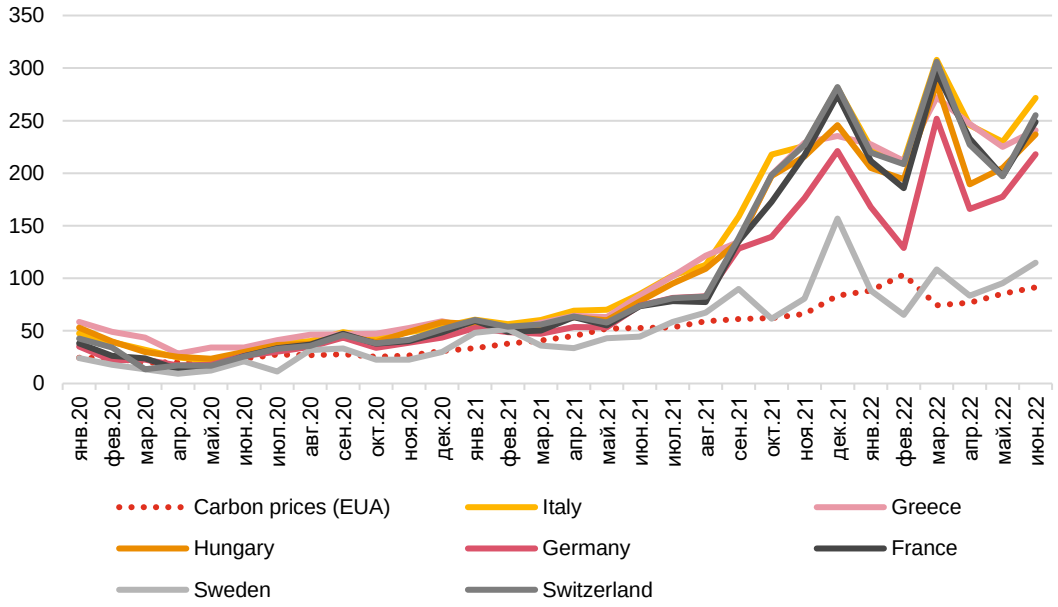
In 2021, carbon prices in the Emissions Trading System (ETS) increased from €33/t to €80/t at the end of the year. In the first half of 2022, prices reached 90 euros/ton. According to the forecast (Reuters), carbon prices will rise to 97.66 euros/ton and 101.96 euros/ton in 2023 and 2024 respectively. Record prices were recorded in the related ETS markets of the EU and Switzerland.

The rise in prices is driven by climate targets and the passage of the Fit for 55 laws in July 2021. In addition, high gas prices lead to the widespread use of coal for electricity generation, which spurs demand for allowances and makes them more expensive.

Since carbon pricing takes into account the total carbon intensity of generating capacity, and in the EU about 40% of electricity is produced by renewable energy sources, rising carbon prices have a significantly smaller impact on electricity prices compared to the impact of fossil fuel prices.

Ember climate, an independent energy think tank, estimates that the increase in carbon costs is 12% of the increase in electricity prices.

Dynamics of growth in the price of carbon* and wholesale electricity prices in the Eurozone, 2020-2022 1H (EUR/ton; EUR/MWh)



*average monthly price based on daily data, ICAP data Electricity prices - Statista.com

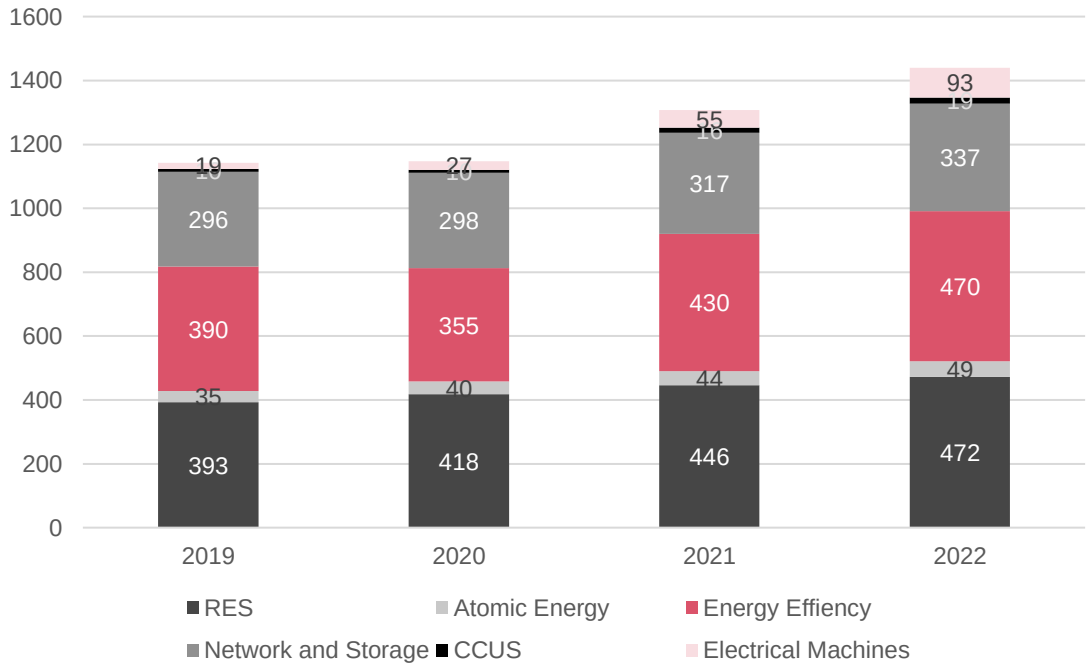
Source: Reuters, World Bank, Ember climate

Due to the energy crisis and rising prices, it is profitable to invest in the generation of clean electricity and, therefore, investments in renewable energy continue to grow

According to the IEA, investments in the **energy sector will grow by 8% to reach $2.4 trillion**, but the increase is due to higher commodity prices and supply problems.

- Investments in renewable energy have been continuously growing since the 2010s, in 2021 solar energy was in the lead, followed by offshore wind farms. The commissioning of renewable energy capacities in 2021 reached almost 295 GW and set another growth record - 6% (an increase of 46% in 2020).
- In 2022, investments in energy storage technologies will increase, but 95% of investments will be made in developed countries and China.
- Rising fossil fuel prices stimulate greater interest in energy efficiency development. In 2021, the volume of investments in the energy efficiency of buildings increased by 16%. Many countries, especially Japan, China and those in the EU, are increasing the requirements for newly commissioned buildings and structures.

Annual investments in clean energy, 2019-2022* (billion US$)



* Forecast of IEA

Source: IEA, IRENA

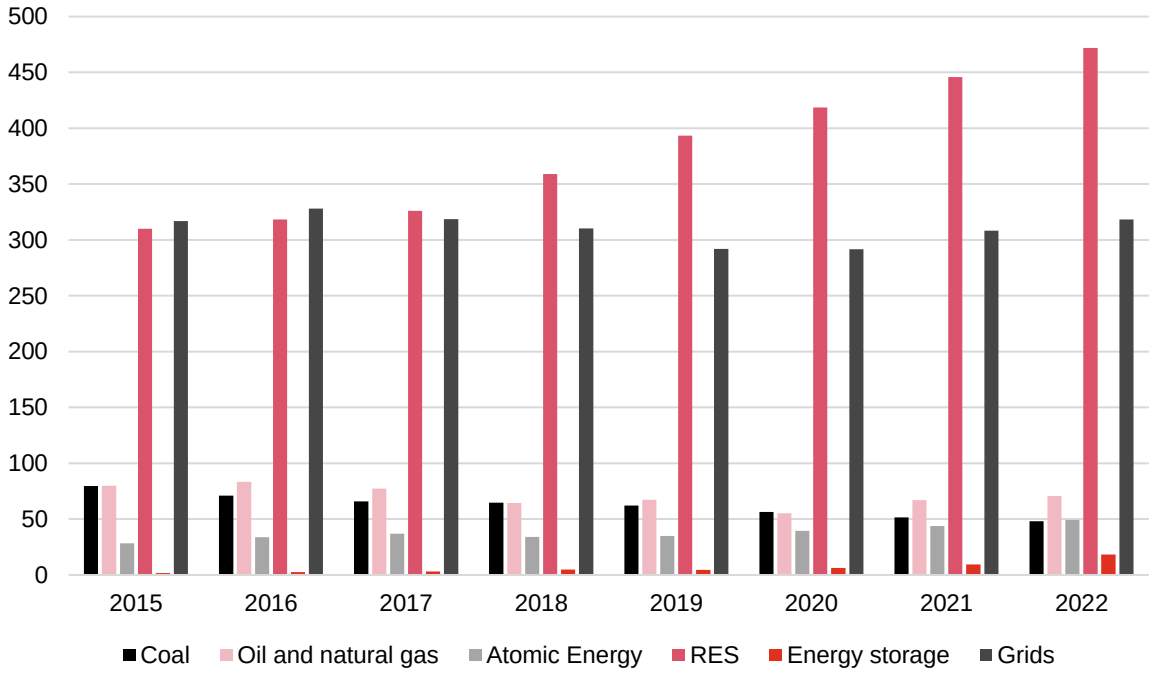
Investments in renewable energy can save up to $55 billion, considering rising prices for fossil fuels

Investments in fossil fuels are growing, but investments in renewable energy dominate in the structure of **investments in generation.**

According to IRENA, in 2022, investments in the development of renewable energy made in 2021 will **save $55 billion against the backdrop of high fossil fuel prices.**

High prices are prompting some countries to increase investment in fossil fuels, however, **the long-term solution to the energy crisis is to shift to clean energy and further increase investments in this direction.**

Annual investments in energy generation in the world, 2015-2022* (billion US$)



*Forecast of IEA

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The role of coal in the energy balance of Kazakhstan

“The high dependence of the Kazakhstani economy on cheap coal may limit the development of energy efficient solutions and clean energy sources, which in turn will lead to a lag in technological progress and the possibilities of using the full potential of the renewable energy sector.”
PwC opinion

- Cheap electricity due to the low cost of coal makes our economy competitive. But when analyzing competitiveness, it is very important to take into account the fact that the coal industry (2019 - 1831.9 million USD; 2020 - 1381.2 million USD, according to the IEA) and electricity **generation receive subsidies from the state, which are not taken into account in the calculation cost of electricity. Moreover, they could be directed to the development of other areas in the energy sector**.
- Existing pricing and subsidy schemes **in the energy sector do not encourage companies to switch to energy efficient technologies and save energy**. Low electricity tariffs do not allow making significant investments in the modernization of generation.
- A clear strategy is needed for the energy transition and the achievement of carbon neutrality targets, taking into account a phased transition **with a combination of different technologies/solutions and a change of the course from energy consumption to the introduction of new energy efficient and clean technologies.**

Source: PwC Analysis

Coal is one of the main energy sources – more than 50% of primary energy in 2021 was produced from coal

Coal reserves:

34 billion tons

Kazakhstan ranks 8th in the world in terms of explored coal reserves

49 deposits

At the current rate of coal production, its reserves will last for more than 200 years

60 million tons

consumed by the energy industry in 2021

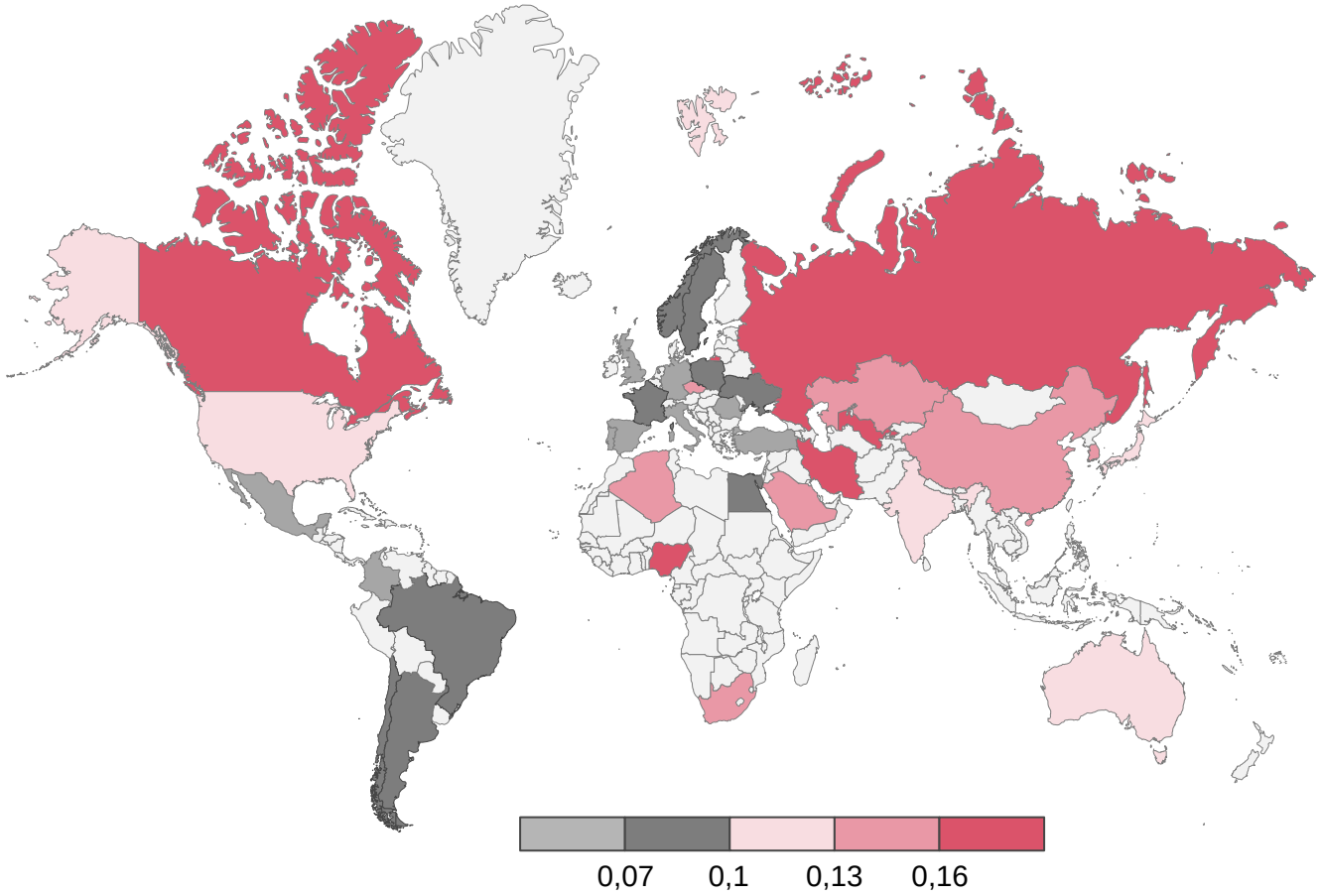
Despite the large reserves of coal in the country, the coal industry in Kazakhstan faces problems of low profitability of additional processing and low demand in the international market. These problems are caused by the physical characteristics of Kazakh coal, which include high moisture, ash and sulfur content. These properties reduce the energy and thermal efficiency of it as a type of fuel, and increase the cost of its processing. Thus, **most of the coal reserves of the Ekibastuz basin (explored reserves - 10 billion tons) are characterized by a high ash content at the level of 42-44%**, which makes its enrichment unprofitable. At the same time, **the coal of the Shubarkol basin (explored reserves - 1.5 billion tons) contains a low amount of ash and sulfur** (5-15% and 0.5%, respectively), which makes it competitive in the world market.

However, coal is the most affordable source of electricity and heat in the country, both because of the low cost of fuel and the existing coal-fired energy infrastructure.

Source: KAZENERGY, open sources

Kazakhstan has one of the most energy-intensive economies in the world

Energy intensity of the economies of the world, 2020



- According to Enerdata, at the end of 2020, Kazakhstan entered the top ten most energy-intensive economies in the world with an indicator of 0.149 koe/$15p. (kilogram oil equivalent per USD at constant exchange rate, price and purchasing power parities of the year 2015)
- The top ten also includes the economies of Iran, Russia, Kuwait, Taiwan, and Canada. Iran has the highest energy intensity of the economy with an indicator of 0.239; US energy intensity was 0.105; Germany - 0.07; and the UK was ranked as the most energy efficient economy in the world with 0.056 koe/$15p, which is three times more energy efficient than Kazakhstan's economy
- Such indicators show low energy efficiency of production. Largely due to outdated equipment and inefficient processes
- **The share of coal in the structure of the energy consumption in Kazakhstan is about 20%**

Source: ENERDATA, IEA

Coal will still play an important role in ensuring the energy security of Kazakhstan

The largest consumers of coal:

70% **Power plants**

Coal-fired generation is the main way to produce electricity and heat in Kazakhstan

20% **Industrial sector**

Traditionally, coal consumption in the industry is mainly accounted for by the coking process in metallurgy

10% **Housing and communal services**

Accounted for by final consumption in the heating season

Coal accounted for more than half of domestic primary energy consumption in Kazakhstan in 2021, amounting to 92 million tons of oil equivalent. Despite the fact that Kazakhstan is implementing a number of programs aimed at achieving carbon neutrality by 2060 (in particular, the development of large-scale use of renewable energy sources), IHS Markit predicts that until 2040, coal will still occupy a significant share in the country's fuel and energy balance and especially in the power generation sector.

Source: KOREM data, NED 2021

25 companies are engaged in coal mining in Kazakhstan

According to 2021 data, more than 75% of coal production in Kazakhstan is provided by two large companies - Bogatyr Komir LLP, which owns the Bogatyr and Severny mines in the Ekibastuz coal basin (40% of total production) and ERG, which produces 35% of coal in the country at the Vostochny open pit in the Ekibastuz coal basin and the Central and Western open pits in the Karaganda coal basin.

Most of the country's coal is mined open-pit

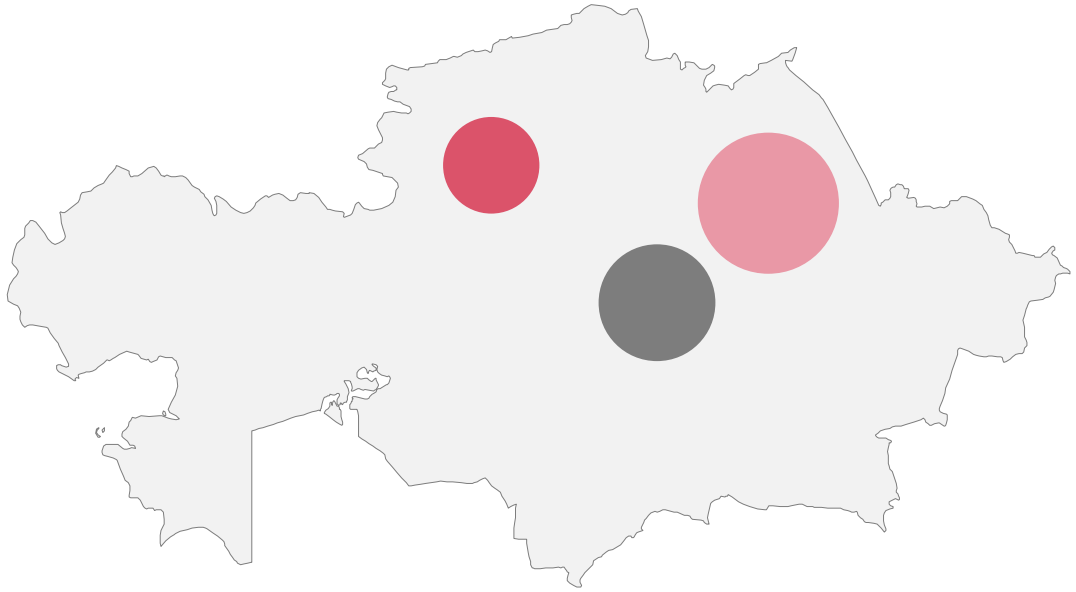
40K people — number of employees in the coal industry

1,5% — The contribution of the coal industry of Kazakhstan to GDP

Coal remains an important industry for the country's economy, but its use has negative effects

2,5 Mill ton — pollutants released into the atmosphere every year

900 K ton — pollutants accounted for for energy



- Ekibastuz coal basin (10 billion tons)
- Karaganda coal basin (7 billion tons)
- Turgai coal basin (6 billion tons)

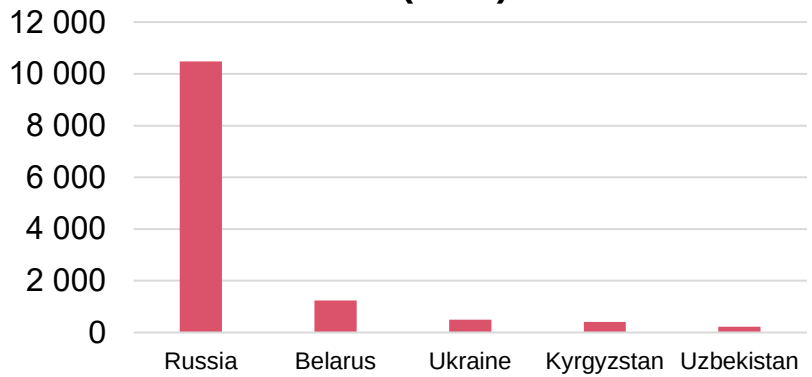
Source: KAZENERGY, open sources

The export of Kazakh coal faced significant logistical difficulties due to the war between Russia and Ukraine

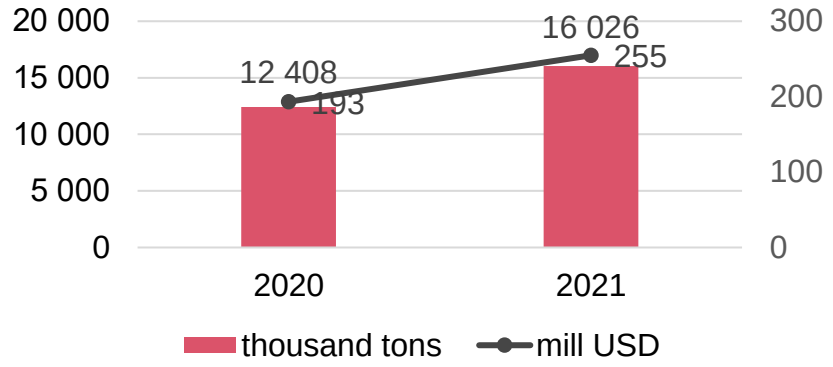
- The Russian Federation remains the largest consumer of Kazakh coal in the world market, with more than 65% of exports in 2021 accounted for the Russian Federation. Deliveries to the countries of Central Asia also increased significantly. However, a further increase in supplying power is difficult due to the lack of transport links and geopolitical tensions in the region.
- In addition, the increase in the supply of Kazakh coal for export is hampered by high transportation costs due to the remoteness of the coal basins from consumption centers and the low quality of products, which reduces competitiveness.
- Insignificant deliveries to the EU countries may even be reduced to zero due to the adoption of obligations by these countries to withdraw coal-fired generation.

  In addition, the low competitiveness of Kazakh coal, caused by low calorific value and high ash content, reduces demand for it in the long term.

Export of coal from Kazakhstan, thousand tons (2021)



Export of coal from Kazakhstan



Source: KAZENERGY, Bureau of National Statistics ASPIR RK

Global experience shows the need for a gradual energy transition, taking into account the reliability of energy carriers

4,4% decline in demand for coal in the world in 2020

6,3% global coal consumption rises in 2021

65% about two-thirds of coal demand comes from China and India

298 $USD was the cost of a tonn of imported coal in the EU in October 2021

At the end of 2020, actual coal consumption turned out to be higher than forecasted, despite favorable climatic conditions and the existence of an agenda to replace coal as part of decarbonization programs.
At the end of 2021, there is an increase in global coal consumption. It was caused by a lack of reserve capacity and unstable climatic conditions, which caused a decrease in RES electricity generation.

Coal consumption is growing in China despite government announcement of a commitment to decarbonize. In addition, according to the IEA forecast, the growth of the Indian economy and further electrification of the country will lead to the burning of an additional 130 million tons of coal by 2024.

In 2021, record coal prices were documented in the EU and in the US, resulting from a sharp increase in demand for electricity against the background of the energy crisis and low coal production rates in these regions. A large number of quarries and coal mines in the EU and the US have been closed for economic reasons.

Source: IEA, BP

Significant investment in fossil fuels could make the development of green and alternative energy in Kazakhstan more challenging(1/2)

100 **Billion tenge**

overall estimate of financing and subsidies for coal energy per year (2019-2021, UNDP)

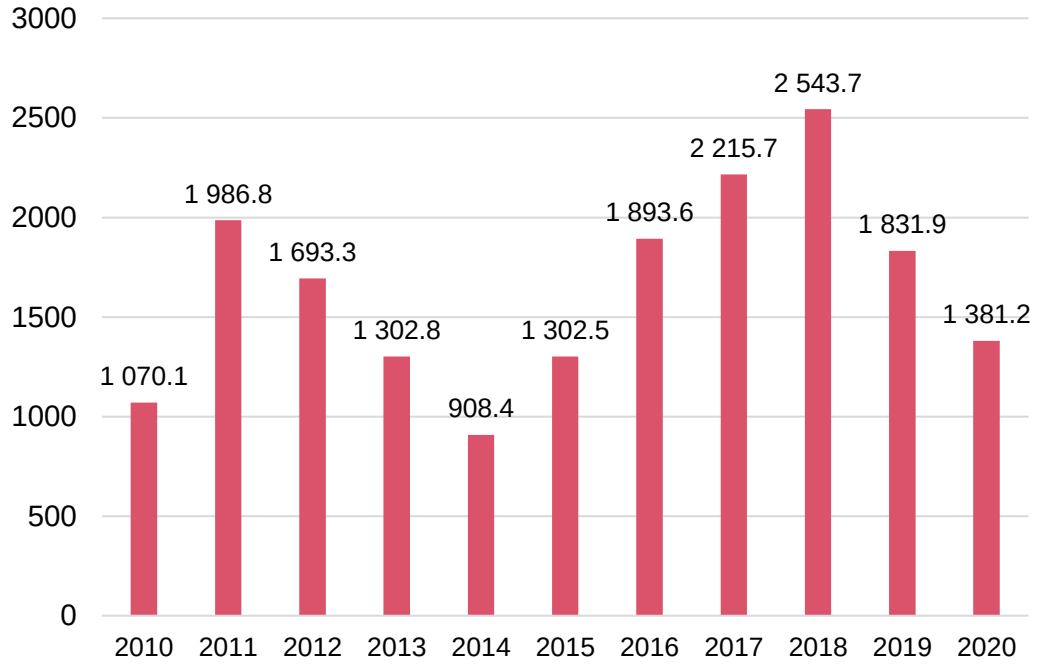
12 **Places in the world**

ranked Kazakhstan in 2020 by amount of investment in fossil fuels

150 **Billion tenge**

was invested in renewable energy in 2021, while 780 billion tenge have been invested in renewable energy since 2014

Subsidies to the coal industry of Kazakhstan according to the IEA, million US dollars



Source: IEA, open sources

Significant investments in fossil fuels lead to difficulties in the development of green and alternative energy in Kazakhstan (2/2)

In Kazakhstan, subsidies are mainly made in the form of:

- direct subsidies to energy producers,
- direct financing of infrastructure projects in the energy sector,
- tax incentives for mining companies,
- price containment for goods and services that form the main share of the cost of coal.

According to global practices, subsidizing fossil fuels can hinder the achievement of low-carbon development goals**. Fossil fuel subsidies can lead to an increase in energy consumption, slowing down the development of renewable and alternative energy and artificially low tariffs.** In addition, there is an acute question of the effectiveness of such a subsidizing mechanism with a low level of implementation of various and market methods for calculating tariffs.

Source: UNDP

The Metals and Mining sector is a major consumer of electricity

More than half of the country's electricity consumption comes from industry

Consumption:

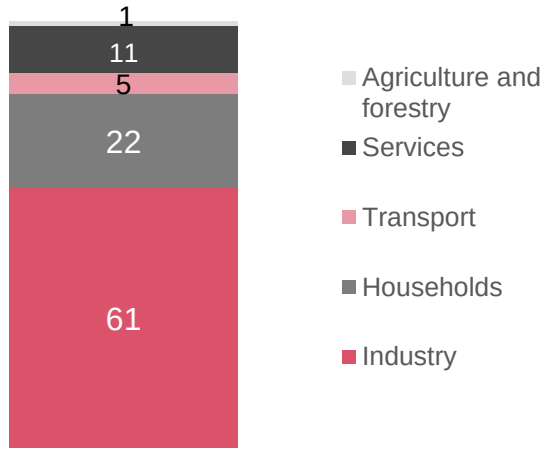
According to 2019 IEA estimates, industry accounts for 61.3% and the housing and utilities sector for 21.5% of electricity consumption in the country. Electricity consumption in Kazakhstan is largely dependent on industrial growth and the state of the world's commodity markets.

About a third of electricity consumption in the country falls on large consumers. Large consumers are mainly represented by companies operating in the mining and metallurgical industry, as well as oil and gas and chemical industries.

37% of domestic electricity consumption falls on the Pavlodar and Karaganda regions, where large MMC facilities are located, while the population of these regions is about 11% of the total population of the country.

The oil and gas industry, located in the western regions, mainly consumes electricity generated from gas.

Structure of electricity consumption by industry, 2019



30% electricity, according to our estimates, is consumed by large industrial groups in the mining and metallurgical sector from the total electricity generation in the country

73% the share of consumption by large MMC enterprises in the industrial sector, according to our estimates

Source: Kazakhstan Electric Power Association, Bureau of National Statistics ASPR RK, KAZENERGY, IEA, Samruk-Energy

Comparative analysis of electricity costs of industrial enterprises of the M&M sector of Kazakhstan and the EU

Sample size and collection of information

Kazakhstan

As noted, cheap coal and low electricity tariffs make our economy competitive, but **the price for such an advantage was a high underinvestment in the modernization and development of the electricity sector**. Since the main share of consumption falls on the MMC in the structure of industrial electricity consumption, the location of the largest facilities of the MMC sector and the main generating capacities in the same region is not accidental – these enterprises are mainly located in the central, northeastern and northern parts of the country, where 95% of all generating capacities run on coal. Next, we provide a high-level analysis to understand if there is opportunity for growth in energy costs.

The largest companies were selected from among the enterprises in the MMC. Many of them are part of industrial groups with their own coal-fired generation facilities. These enterprises are mainly located in Pavlodar, Karaganda, Kostanay and East Kazakhstan regions.

Source: Kazakhstan Electricity Association (2020), European Commission Report (2020)

The top 10 enterprises in terms of electricity consumption include:

- TNC Kazchrome JSC (extraction of chromium and manganese ores, ferroalloys)
- JSC "Kazakhstan electrolysis plant" (production of primary aluminum)
- ArcelorMittal Temirtau JSC (production of steel products)
- Kazzinc LLP (zinc production and related production of copper, precious metals and lead)
- KazPhosphate LLP (mining, processing of phosphorus ore and production of phosphorus-containing products)
- JSC SSGPO (mining and processing of iron ore)
- GC LLP "Corporation Kazakhmys" (extraction and processing of copper ore)
- JSC Aluminum of Kazakhstan (mining and processing of mineral raw materials)
- JSC "UK TMK" (extraction of raw materials and production of finished products)
- Kazminerals LLP (extraction and processing of copper ore)

According to our estimates, their total electricity consumption is 68% of the consumption of the entire industrial industry.

Data on the share of electricity costs in the total costs of the enterprise for the production of products were obtained on the basis of the audited financial statements of enterprises for 2020.

European Union

Data on the share of electricity costs in the total production costs of enterprises in the EU mining and metals sector were used as an average for the EU (27 EU Member States) based on the report of the European Commission on the topic: "Energy prices and costs in Europe".

The costs of the Kazakh mining and metals sector for electricity are much lower than in Europe

Comparison results of Metals and Mining sector

10-20% **9%**

The average share of electricity in the production costs of enterprises in the mining and metallurgical industry

The share of electricity in the structure of production costs of M&M enterprises in Kazakhstan is significantly lower than the European level. This high-level comparison can serve as an example of how, despite high electricity tariffs and relatively high labor costs, European businesses keep margins at acceptable levels while remaining competitive.

Share of energy costs in the most energy-intensive sectors of the steel industry:

Primary aluminum production

40% **20%**

Ferroalloy production

28% **18%**

Source: European Commission Report (2020)

Profitability of Kazakh M&M enterprises 10 p.p. higher than in the EU due to lower production costs (incl the cost of electricity)

We turned to data from the statistical office of the European Union (Eurostat) to estimate the profitability* of the mining industry in Europe.

** Profitability ratio = gross profit (excluding depreciation costs) in relation to revenue*

32%

The average profitability of the metal ore mining sector in the EU in 2019.

Most of the metal ores supplying the European iron and steel industry are imported. Only a few EU countries have active mines. These include **Austria, Finland, Greece, Ireland, Poland, Portugal and Sweden**. In these countries, metal mining accounts for more than 1% of the world production of one or another metal mineral raw material.

As the experience of developed countries shows, there is a possibility of existence with lower profitability. At the same time, it is important to evaluate operational efficiency, which should be at a sufficiently high level, taking into account higher prices for both electricity and labor.

To assess the profitability, the same indicator was used as for the EU. The data for each enterprise was taken from the audited accounts for 2019.

43%

The average profitability of enterprises from the sample for 2019.

The profitability of mining companies in Kazakhstan is almost a third higher than the EU average, including due to low energy prices, subsidies for energy transportation, low electricity prices, as well as tax incentives.

Source: Eurostat, European Commission

Elimination of subsidies for the coal industry will raise prices for heat and electricity, and consequently, the cost of production of M&M enterprises

35% The maximum increase in the heat tariff with the abolition of coal subsidies according to UNDP calculations

11% The maximum increase in the tariff for electricity with the abolition of subsidies according to UNDP calculations

In order to prevent the growth of prices for socially important heat energy, it is necessary to adjust the methodology for distributing the costs of energy-producing organizations

The physical method of cost allocation currently used has a number of disadvantages that do not allow for a correct assessment of the impact of subsidies on tariffs.

According to the Rules for the formation of tariffs, the distribution coefficient for the supply of electricity and heat is determined according to one of the methods chosen by the subject: physical or exergy.

In fact, only one method is used – physical.

Economic or market methods of cost allocation consist in determining economically justified costs for each type of product, i.e. thermal and electrical energy. When applying economic approaches, the cost of electricity and heat produced at CHP is determined without splitting fuel costs, since there is no one indisputable and impeccable way to divide the fuel consumption at CHP between electricity and heat.

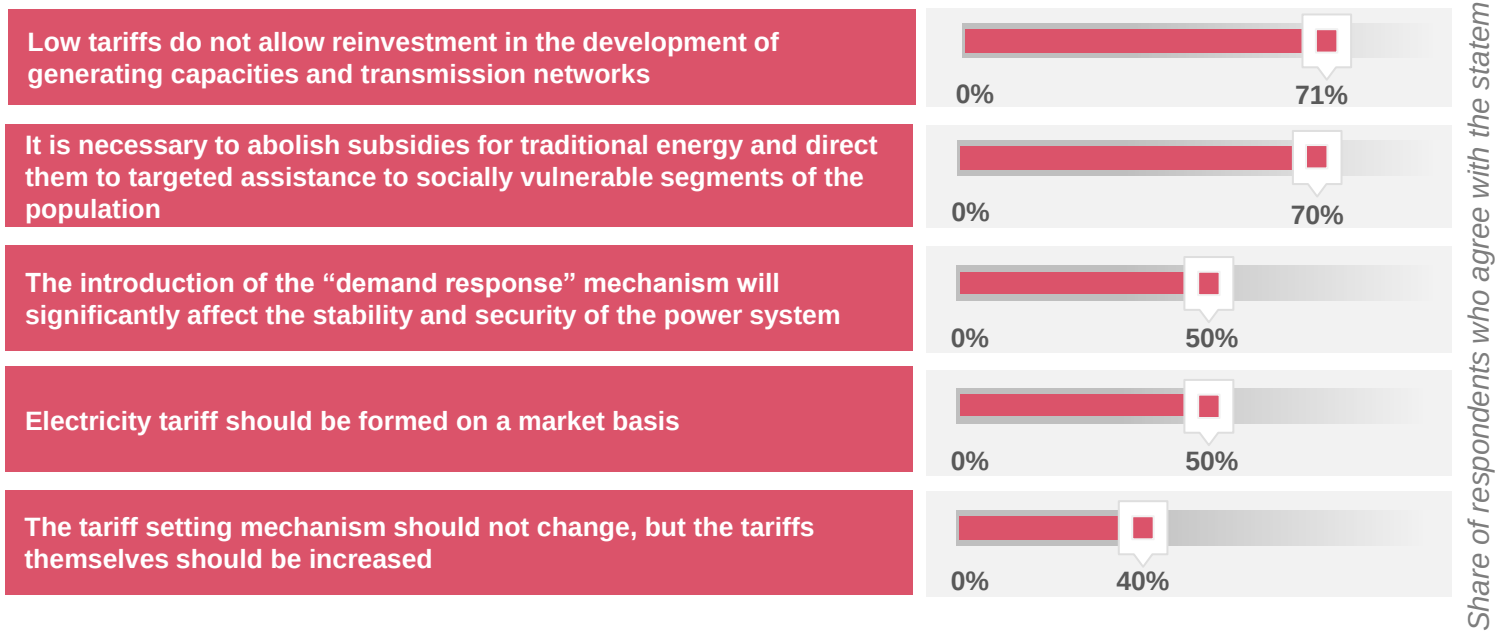
Source: UNDP

Poll results: current low tariffs do not allow energy development (1/2)

Most respondents agree with the statement that electricity tariffs in Kazakhstan, as well as prices for primary fuel, are too low and do not allow effective investment in the development of generating capacities and transmission networks.

At the same time, various ways out of the current situation are proposed. Respondents were asked to change the tariff setting mechanism, improve the wholesale electricity market and the capacity market, and introduce a balancing electricity market.

Respondents also agree with the need to abolish subsidies for traditional energy and develop targeted assistance to consumers.



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The existing system of tariff formation in the energy sector of Kazakhstan hinders its development, investment plans are not being implemented in the proper amount, and innovative developments are not being introduced. The current tariff formation methodology is essentially a cross-subsidization of consumers, setting very low tariffs for the population and unreasonably high for budgetary organizations and businesses.

Since energy facilities are subjects of a natural monopoly and their profitability is determined strictly according to the tariff estimate approved by the Antimonopoly Department, there is no talk of capital modernization, let alone the construction of new facilities. The new mechanism, the capacity market, was designed to reduce the burden on the owner by shifting part of the costs of building or maintaining existing facilities to all participants in the wholesale market, including consumers in the end.

There is also the issue of the lack of a systematic approach in the housing and communal services sector. Without a clear strategy, its reform is impossible, and a chronic lack of available budget from year to year leads to serious technical degradation of house equipment - rusty pipes and "leaky" walls.

Zhakyp Khayrushev

Expert in the field of electric power industry, Honored Power Engineer of Kazakhstan

Poll results: current low tariffs do not allow energy development (2/2)

In the developed countries of Europe and the USA, the RAB method of regulation is used (Regulatory Asset Base - a regulated base of employed capital, a value established for the purpose of regulating tariffs, reflecting the market value of a company's assets, taking into account their physical depreciation).

Our suggestions in this regard:

- Conduct a total analysis of the solvency of the population to determine the low-income layer of citizens and the implementation of targeted social assistance;
- Review the current tariff setting methodology in the natural monopoly sector and adopt a new methodology based on RAB regulation;
- Consider the possibility of increasing the payment for MW of power to all energy producing organizations that have passed the appropriate certification as part of the service of readiness to maintain electric power to the required level for real modernization and construction of new generating capacities;
- Develop a Program for the development of communal infrastructure systems in the cities of Kazakhstan.

Zhakyp Khayrushev

Expert in the electric power industry, Honored Power Engineer of Kazakhstan

The issue of introducing a single buyer mechanism in the electricity market has been discussed for several years. The current situation requires increased transparency and fair tariff setting. It is necessary to develop in detail the mechanism of a single buyer in order to exclude the benefits of individual groups.

Ainur Sospanova

Chairman of the Board of the Association of Legal Entities "Qazaq Green Association"

Changing the method of allocation of costs of energy-producers will reduce the impact of tariff growth on the cost of heat

Currently, there are a number of methods for allocating costs by type of product. Among them, the most common are:

- **physical method;**
- **exergy method;**
- **normative method;**
- **economic methods.**

The transition to market methods of cost distribution will make it possible to more fairly calculate the ratio of EPO costs for the generation of heat and electricity, which in turn will allow targeted reforms in the tariff formation processes in the electricity and heat market.

Due to the social significance of heat energy prices, the regulator implements a policy of curbing the growth of heat tariffs, which leads to their underestimation. This does not allow the (thermal) energy producers to save & invest in renewal of their fixed assets. As a result, currently any major investments in generating capacity and infrastructure requires state financing and subsidies.

Distribution method	The main advantages of the method	The main disadvantages of the method
Physical method	simplicity of calculation and clarity, establishing a direct dependence of the cost of electric and thermal energy on the production and technical indicators of the CHP plant	overestimation of the cost of thermal energy and artificial reduction of the cost of electrical energy
Exergy method	obtaining a unified quantitative approach to all types of energy flows	- increase in specific fuel consumption for electricity supply - increase in the cost of electricity
Normative method	the division of costs in complex production occurs in proportion to the corresponding types of costs	the impossibility of determining the total fuel consumption, with combined generation, at the design stage without using the "physical" method
Shutdown method	- Ease of use - Visibility	the tariff of one type of product is completely dependent on the tariff of another type
Separation method in proportion to cost	savings from the combined production of electricity and heat at CHP are distributed between both types of energy	difficulty in determining cost allocation ratios

Source: UNDP

Abolition of "coal" subsidies and the increase in electricity tariffs require transformation of the state mechanism, industry support and tariff setting

It is essential to consider the possibility of switching from a system of support for energy-producing organizations to targeted subsidizing of consumers. Targeted subsidizing of consumers is closely linked with the differentiation of the tariff for individuals and legal entities, as well as for individuals, depending on the level of income. (International experience shows a main risk of elimination of subsidies is the subsequent increase in energy tariffs and a disproportionate (negative) effect on low-income households.)

5,3%

share of the population of Kazakhstan with an income level below the subsistence minimum for 2021

2,3-2,6
billion tenge per year

estimated amount of compensation for growth tariffs for electricity and heat*

* - according UNDP calculations

In carrying out the energy subsidy reform, it is necessary to pay special attention to the protection of socially vulnerable segments of the population. It is necessary to determine the level of income of various segments of the population and distribute subsidies according to the calculations.

Targeted subsidizing of consumers requires significantly less financial costs.

Since the share of the population of Kazakhstan with an income level below the subsistence level in 2021 was 5.3%, according to UNDP calculations, the amount of compensation for the amount of growth in tariffs for electricity and heat (for people with an income level below the subsistence minimum) will be 2.3-2.6 billion tenge per year, which is much less than the amount of subsidies allocated to energy producing organizations.

Source: UNDP

Making changes to the tariff policy and the legislative framework is a necessity for resolving energy security issues

The coal industry will remain the basis **for our energy security and independence for the time being, but the further development of the energy system is inextricably linked with the introduction of renewable energy and new energy efficient technologies that require significant investment and the creation of the right institutional framework**. Investment in conventional energy is declining around the world and achieving carbon neutrality requires significant efforts to change the direction of the energy system.

Kazakh companies working on a low-carbon development program or strategy

	KMG	ERG	Kazakhmys	ArcellorMittal	SK Foundation	KPO
Targets to reduce greenhouse gas emissions	**-15% by 2031**	**-56%* and 2 million tons by 2030**	**-20% to -40% by 2030**	**-25%** by 2030**	**-10% by 2030**	**CN*** by 2037**

Energy security

The combination of various clean and energy efficient technologies, as well as smart grids, taking into account the need to modernize the energy system, will lead to an increase in its stability.

Long-term risks

The risks of climate change will affect the energy system, and its instability will lead to risks for the economy and the state. In the long term, the impacts of climate change will increase.

Technology Development

Investments in digitalization will give impetus to the development of clean technologies such as smart metering systems, vast area management systems, renewable/clean energy sources, electric transport and the Internet of things.

* Reduced particulate emissions
** Goal at the global group level
*** Goal for achieving carbon neutrality for Scope 1 and 2

3

RES in Kazakhstan and its development

Legislative support for RES development continues to increase

In the last issue devoted to the RES market "RES Market in Kazakhstan: Potential, Challenges and Prospects" we outlined the key changes in the legislation for the period from 2009 to 2020.

The adopted laws, in particular, investment and tax preferences, and the creation of the FSC under the system operator gave a noticeable impetus to the development of renewable energy in Kazakhstan.

However, some of the important challenges noted by our respondents were the need to introduce the Balancing Electricity Market (BEM) and stimulation of microgeneration.

2021 The following changes were made to the law to support renewable energy:

The concept of **"the use of secondary energy resources"** was added. This category of projects will be supported with renewable energy sources.

Secondary energy resources - energy resources generated as a by-product in the process of industrial production in terms of the use of ferroalloy, coke and blast furnace gases used to produce electricity.

Amendments have been adopted to introduce the mechanism of **energy utilization of waste** through its combustion and electricity generation. The entire volume of generated energy will be guaranteed to be purchased by the state, similar to RES projects, for a period of 15 years.

Since July 2021, a **premium is applied to support the use of RES** and the selling price of conventional plants is divided into two components:

- the electricity tariff, which consists of the cost of electricity production and the rate of return determined by the methodology established by the authorized body,
- surcharge to support the use of renewable energy sources, determined by the FSC for the calendar year.

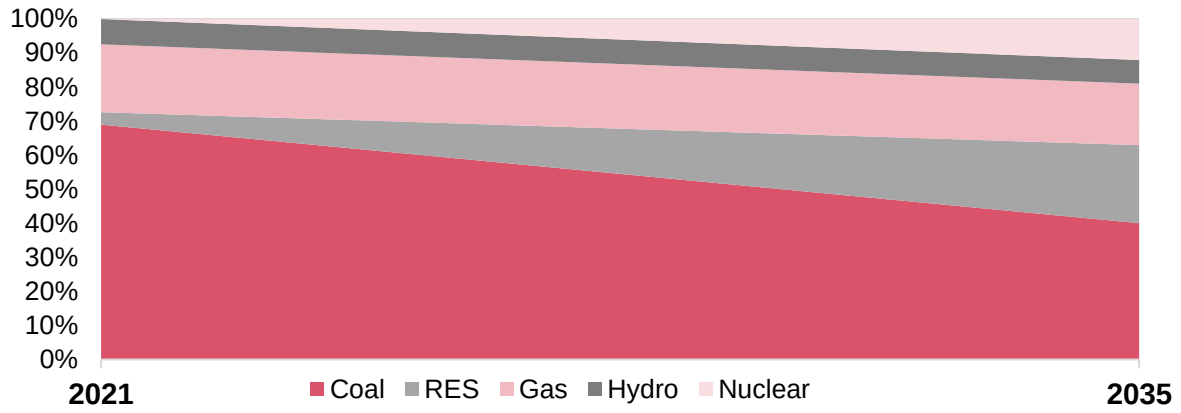
Sources: Benchmarking bank of regulatory legal acts

In 2021, Kazakhstan announced its intention to achieve carbon neutrality by 2060

According to the roadmap for the implementation of NDCs, intermediate goals are set (for 2021-2025 and until 2030):

- Optimization of the emissions trading system (reduction of free allowances, coverage of a larger sector of the economy)
- Reducing the share of coal in electricity generation to 40% of the total in 2030
- Increasing the share of renewable energy sources (solar, wind, hydro) from 3% to 24% of the total volume by 2035
- Increasing electricity production by using natural gas to 25% by 2035
- Increasing economy-wide energy efficiency by 38.9% by 2030 and reducing carbon intensity by 41.4%

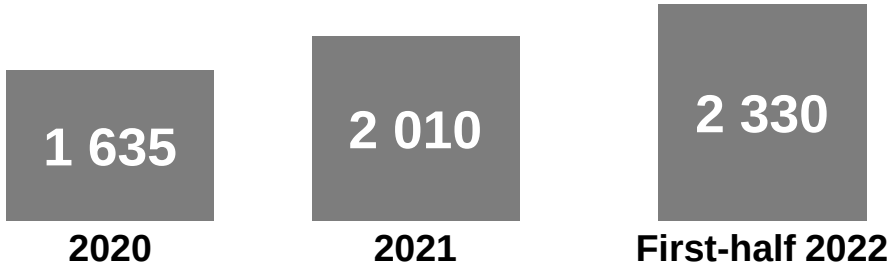
Breakdown of power generation in 2021 and forecast by 2035.



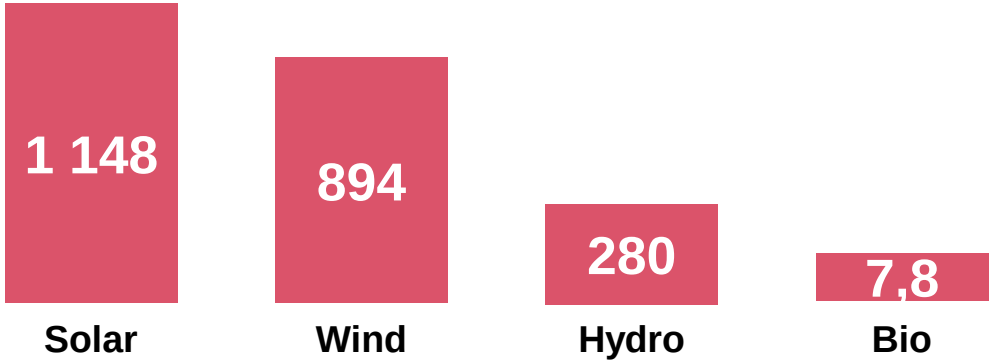
- According to the Ministry of Energy, **further commissioning of new coal-fired generation is limited**, due to the refusal of international financial institutions to finance coal-fired power plant construction projects
- By 2035, it is required to ensure commissioning of new generation capacities, of which **11 GW are low-carbon generation sources**, including 6.5 GW of RES facilities (solar and wind)
- There are plans to build nuclear power plants, presumably on the shore of Lake Balkhash (Ulken settlement), with a capacity of 2.4 GW

Electricity generation by RES facilities in 2021 increased by 30% (1/2)

Total capacity of RES facilities, MW



Installed capacity of RES facilities, June 2022 (MW)

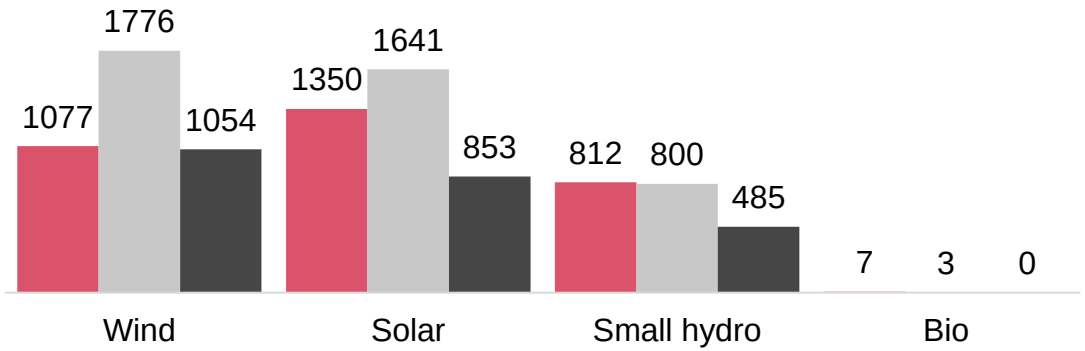


Data from KEGOC, Ministry of Energy RK

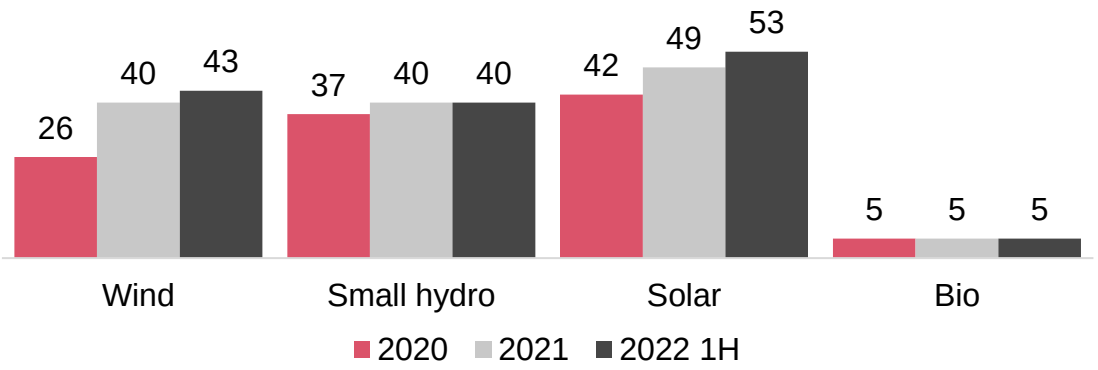
- The share of electricity generated by RES facilities in the total volume of electricity generation in 2021 was 3.7% (2020 - 3%), **in the first half of 2022 - 4.24%.**
- The volume of electricity production by RES facilities in 2021 amounted to **4,220.3 mil kWh**. Compared to 2020 (3,245.1 mln kWh) the increase was 30.1%.

Electricity generation by RES facilities in 2021 increased by 30% (2/2)

Electricity production by RES facilities in 2020-2022 1-half year (mil kWh)



Total number of RES, 2020-first half of 2022



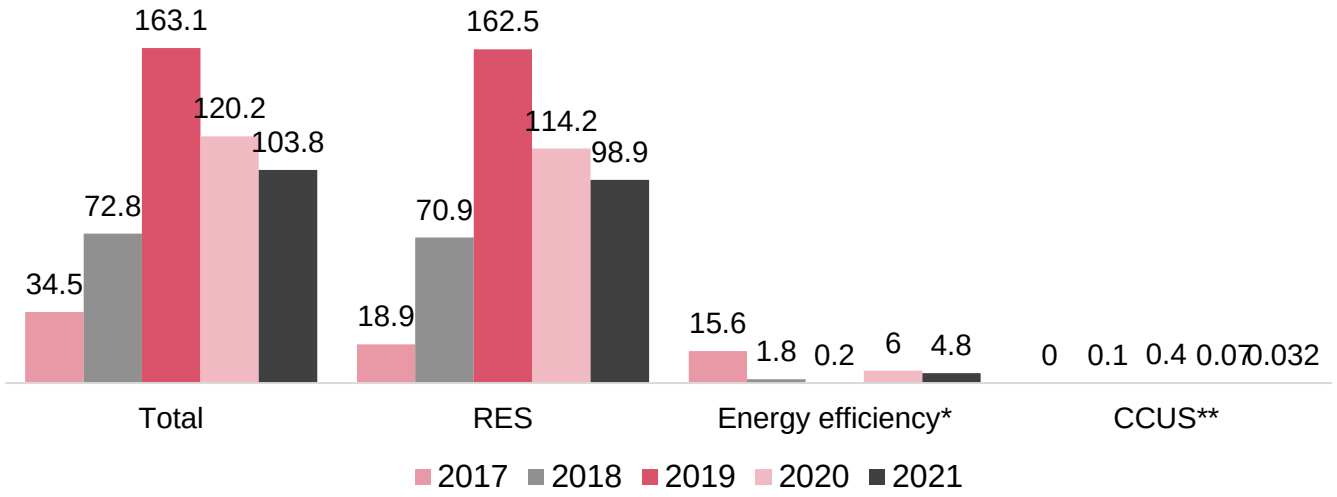
Most of the electricity generation among RES facilities **came from wind power plants - 42.1%,** annual growth for 2021 - 65%. Despite the large installed capacity, solar power plants generated less than wind power plants, **38.9%**, an increase of 21.6%.

> At the same time, further growth of the RES share in the country's energy balance will require additional efforts from the system operator to balance imbalances in power generation and consumption. In addition, the impact on the end consumer's tariff will increase. Creation of maneuverable generation and close work with the RES producers is the key to the development of the sector in the country.
>
> **Ainur Sospanova**
>
> Chairman of the Board of the Association of Legal Entities "Qazaq Green Association"

Conditions for RES development improve, but further reforms are needed

In Kazakhstan, investments are made in the field of renewable energy sources, energy-saving technologies and energy efficiency, as well as investments aimed at environmental protection activities. The main sources of investment were the enterprises' own funds, budgetary and other borrowed funds, and bank loans.

Investments in the "green economy" of Kazakhstan, billion tenge



* Energy-saving technologies and energy efficiency

**Reduction of greenhouse gas emissions

Future major renewable energy projects:

TotalEnergies

The French company Total Energies is planning to build a wind power plant with installed capacity of 1,000 MW and electric energy storage systems with a capacity of 200 MWh. This project will be a pioneer in the field of hybrid RES power plants in Kazakhstan.

UNDP

The United Nations Development Program implements a project to reduce the risks of investing in renewable energy with the financial support of the Global Environment Facility. The project is aimed at attracting investment and implementation of both large-scale and small-scale RES projects.

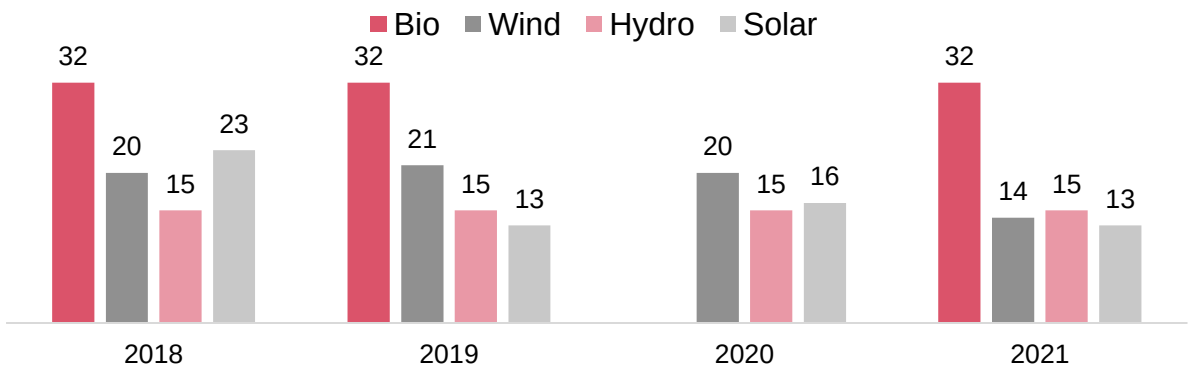
Source: UNDP, media analysis, Bureau of National Statistics of the Republic of Kazakhstan, open sources

Tariffs have decreased over the past 4 years due to the introduction of the auction mechanism

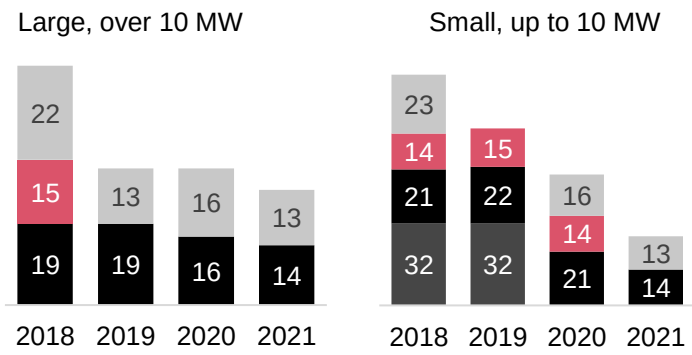
Projects won by auction

2018	30
2019	11
2020	14
2021	8

Average auction price of RES facilities, tg/kWh



Average auction price by type of RES facilities, tg/kWh



> The mechanism of auction bidding has proved its consistency and efficiency by launching the process of RES integration into the energy system of Kazakhstan. In addition, the mechanism continues to improve, offering new ways of auction bidding. Bidding is conducted with ready documentation, technically-neutral auctions are under discussion.
>
> **Ainur Sospanova**
>
> Chairman of the Board of the Association of Legal Entities "Qazaq Green Association"

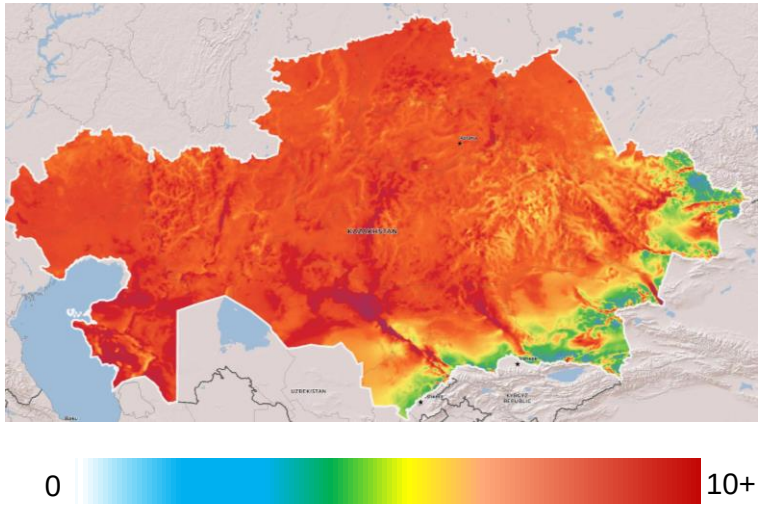
Auction price is the price for the purchase by the Settlement and Financial Center of electric power generated by the renewable energy facility, determined by the results of the auction bidding and not exceeding the level of the relevant ceiling auction price.

Sources: KOREM, USAID

Kazakhstan has significant renewable energy potential

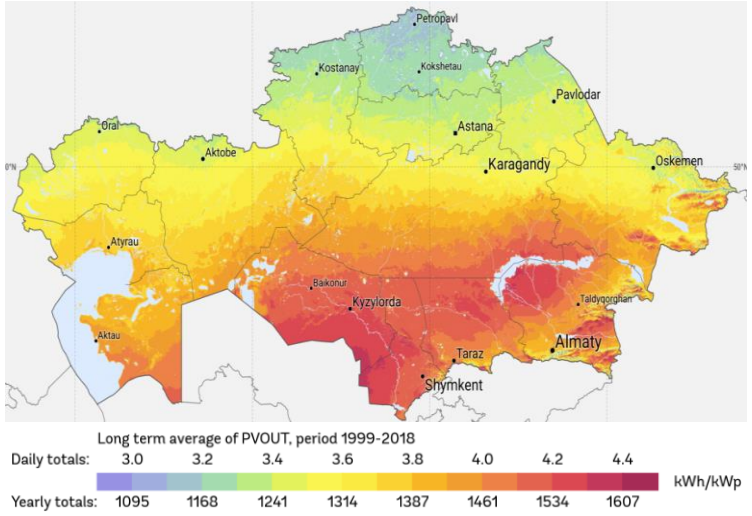
The peculiarities of the grid infrastructure of Kazakhstan's energy system create certain difficulties for the full-scale integration of renewable energy. Wind potential, concentrated in the northern and western regions, does not find sufficient demand for electricity generated by wind power plants, as demand centers are located in the southern regions. Conversely, the busy grid infrastructure of the southern regions is unable to accommodate large volumes of solar generation.

Map of average wind speed in Kazakhstan, World Bank, m/sec



https://globalwindatlas.info/

Map of solar panel potential in Kazakhstan, World Bank



https://globalsolaratlas.info/map

The western and northern regions of the country have the greatest wind energy potential along with significant land resources. The southern regions have more limited wind resources along with grid constraints.

Solar energy potential is concentrated in the southern and western regions, as well as the Karaganda region.

Kazakhstan's total hydropower potential is 170 billion kWh per year. At the moment, 62 billion kWh is recognized as technically achievable, of which 30 billion kWh per year is economically feasible for use.

Sources: World Bank, IEA, open sources

Further growth of renewables requires reform and technology development

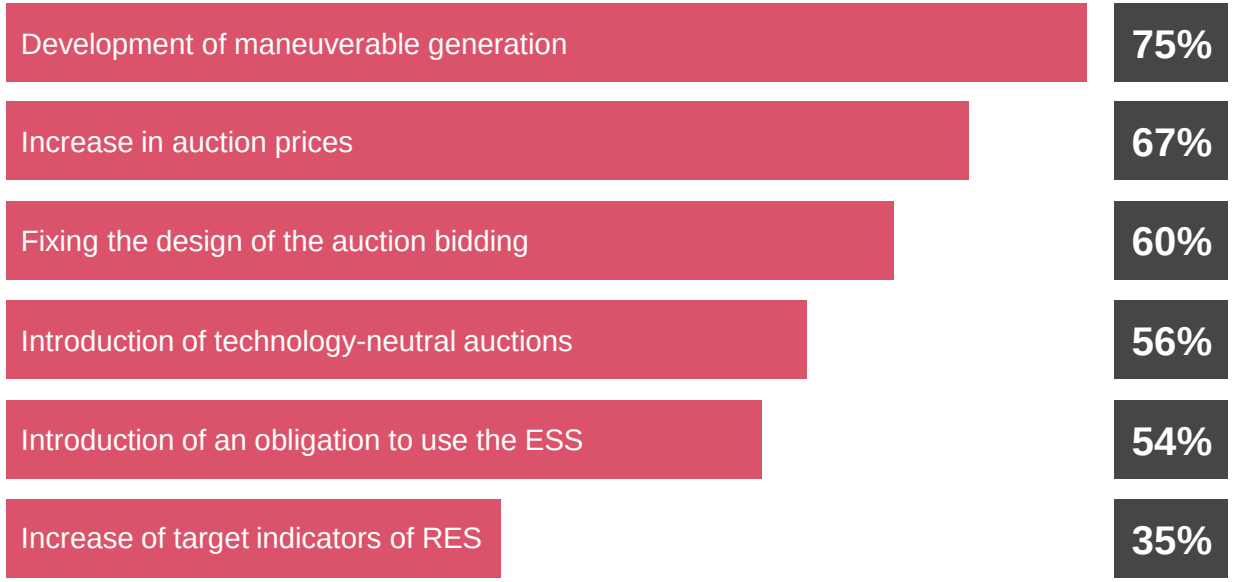
Regarding the increase in target indicators of renewable energy, respondents' opinions were divided. The refusal to increase is motivated by the lack of maneuvering capacity and lack of scientific potential, while the need to increase is explained by the importance of meeting the obligations to achieve carbon neutrality.

- The majority of respondents note the importance of development of maneuverable generation and small-scale RES generation.
- Regarding the auction bidding RES, respondents point to too frequent changes in the design of bidding and their energy mix, the low level of auction prices.
- Proposals for technology-neutral auctions and the introduction of energy storage systems were voiced.
- It was also proposed to assess in detail the types of maneuverable capacities: perhaps GTU or GPU are more optimal than CCGT, which are planned to build, assess the potential of pumped hydro storage plants, the prospects for other ESS

Further development of RES requires the deployment of new technologies:

- energy storage systems,
- CO_2 capture and storage systems (CCUS),
- production and use of hydrogen,
- modernization of the grid and implementation of Smart Grid technology.

In addition, respondents identified the main areas of support for RES development in Kazakhstan:



Energy storage systems: balancing unstable wind and solar generation will be crucial

The development of wind and solar energy requires solving the issue of their unstable generation. In addition to the introduction of maneuvering capacity, it is necessary to deploy energy storage systems (storage batteries).

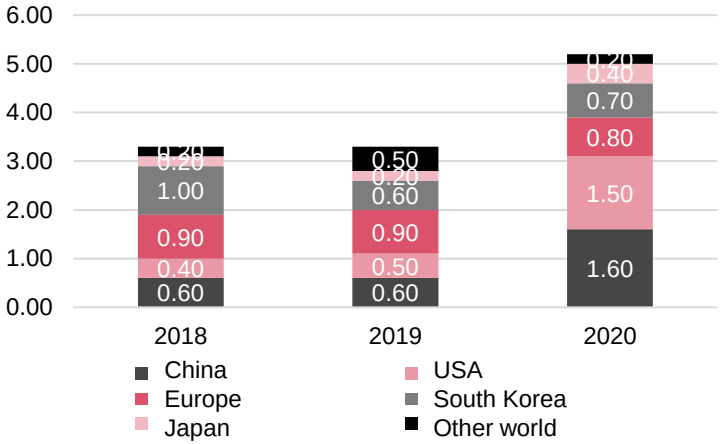
Storage systems and solar energy can complement each other, as the average storage cycle of storage batteries (4-8 hours) is combined with the daily solar cycle.

There is a growing investment in this sector. By 2025, China plans to build about 30 GW of non-hydro energy storage capacity, and the U.S. more than 20 GW.

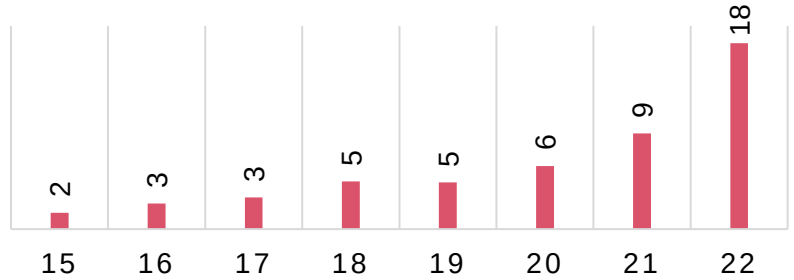
According to the Ministry of Energy, auctions for the selection of RES projects using the energy storage system are planned for 2022. It is also planned to build the first wind power plant with energy storage (Total Energies project, *more details on page 47*).

The inclusion of storage batteries will increase the cost of RES projects, which will require higher tariffs in the future.

Energy storage capacity growth by country, 2018-2020 (GW)



Investments in batteries worldwide 2015-2022* (mil USD)



* according to the IEA forecast

Sources: IEA, open sources

> We assume that the task of commissioning maneuvering capacity should be performed centrally by the system operator, and not shifted to the shoulders of investors. Or, alternatively, a fair tariff should be offered.
>
> **Anonymous**

Kazakhstan's energy security can be enhanced by a number of reforms

According to the results of the survey, in order to ensure the energy security of Kazakhstan, the respondents noted the importance of deeper integration of energy systems in Central Asia, which will have a positive effect on reliability and stability, and the introduction of the requirement to equip ESS based on chemical elements in the auction bidding for all newly commissioned RES power plants. In addition, the importance of developing gas-fired generation as both maneuvering and baseload capacity was noted.

The graphs below show the percentage of respondents agreeing with the choice of one initiative or another.

79%

Integration of Central Asian Power Systems

54%

Equipping ESSs based on chemical elements as part of the auction bidding for all newly commissioned RES power plants

54%

Gas generation is the most suitable for the task of creating maneuvering capacity

40%

Gas power is capable of replacing coal power as the base capacity in Kazakhstan's energy system

1. To solve the issue of ensuring the stability of parallel operation of power systems of Central Asia with Unified Electric Power System of Kazakhstan and Unified Electric Power System of Russia it is proposed to apply in the United ES of Central Asia DC inserts on 500 kV Shu-Frunze overhead line.

2. In order to use water efficiently and create peak capacities to compensate the impact of RES in the region, it is proposed to build hydroelectric power plants, making maximum use of existing reservoirs for this purpose, and to intensify efforts for joint construction of Kambarata and Rogun HPPs.

3. It is necessary to establish cooperation between electric and gas network operators, not only within the country, but also in the region, which should ensure the operation of the GTS in accordance with the schedule of the energy system.

4. The probability of imbalance of power transferred from RES to transit North-South of Kazakhstan increases a lot. It is necessary to determine the allowable share of RES in the generating capacity of Uzbekistan and Kazakhstan by conducting special studies, as well as other measures to maintain sustainable operation of energy systems.

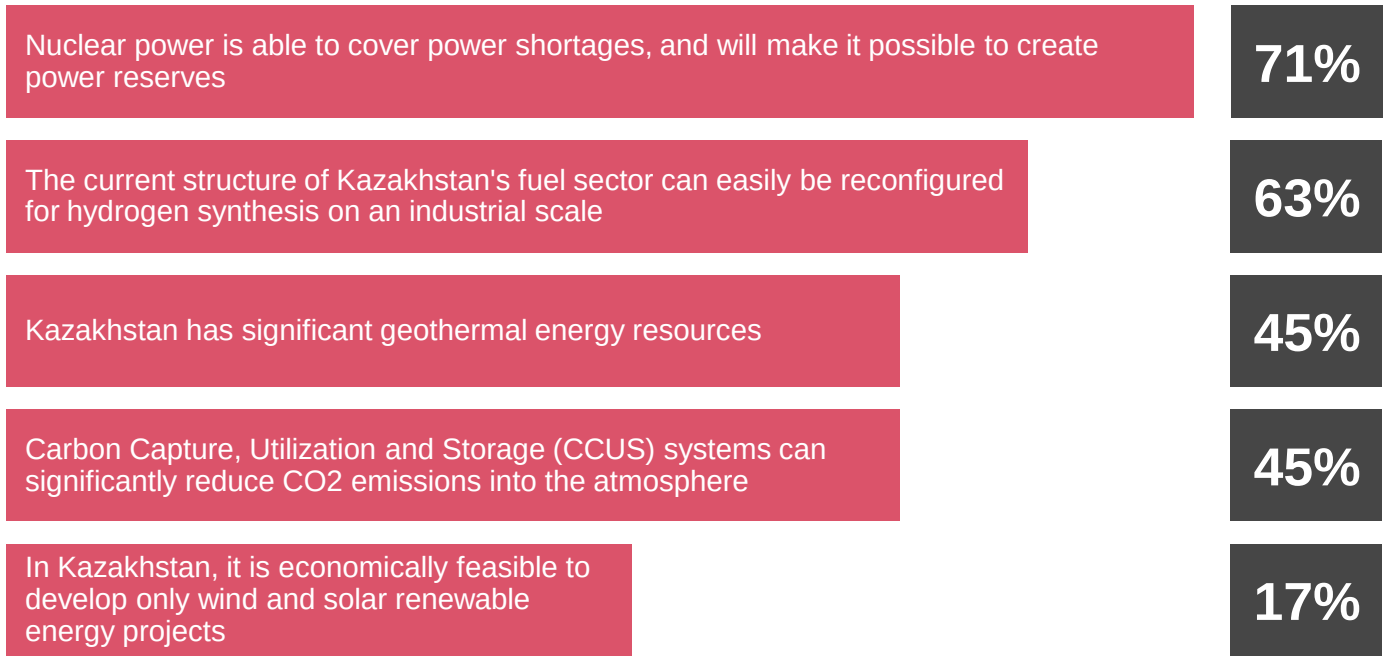
Zhakyp Khairushev

Expert in the field of electricity, Honored Power Engineer of Kazakhstan

The potential of new technologies is highly valued by respondents

In order to further develop the energy sector and clean technologies, it is necessary to introduce new technologies in Kazakhstan.

The results of the respondents' survey show the importance and necessity of developing nuclear energy, hydrogen synthesis and a number of other technologies that are successfully used in world practice.



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According to a study conducted by UNDP, Kazakhstan has significant low-temperature geothermal resources that can be used as thermal energy. At the moment, it is extremely important to create a pilot project that will calculate the costs and assess the risks of a large-scale deployment of geothermal systems.

Ainur Sospanova

Chairman of the Board of the Association of Legal Entities "Qazaq Green Association”

“

Along with solar and wind energy, attention must be paid to hydropower and hydrogen energy. The development of hydrogen requires setting achievable target indicators at the state level. It is important to decide whether we will be able to include it in the country's domestic energy balance or focus on exports. As far as I am concerned, we have great potential for both development options.

Almaz Abildaev

Director of the Energy Aspects of Kazakhstan Research Center

The need to introduce CCUS technologies is due to the specifics of the energy market in Kazakhstan

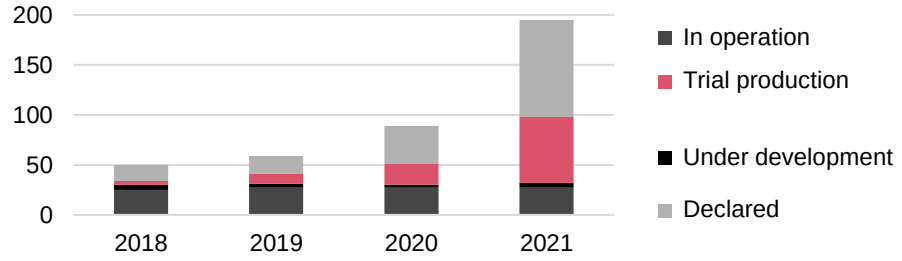
The adoption of carbon neutrality goals stimulates the development of CCUS projects. 71% of the capacity of existing CCUS projects are installed in natural gas processing plants. However, 30% of the projects under development are planned to be installed at hydrogen production projects, about 10% - production of iron, steel and cement, 20% - biofuels.

Imperial College London estimates the capital costs of building coal-fired power plants with CCUS/CCS implementation range from $3,552-$6,816. The cost of building a CCUS/CCS coal-fired power plant is estimated at between $3,552 and $6,816 per kW, which is much higher than the cost of conventional plants.

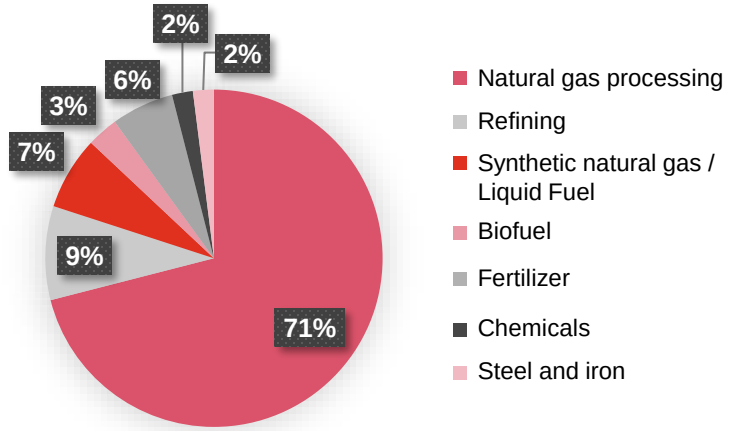
There are no industrial CCUS projects in Kazakhstan. A good base for the deployment of this technology is the developed oil industry and the availability of reservoirs for carbon injection.

According to the Roadmap for implementation of the renewed CCUS in Kazakhstan, the price of carbon should reach $50.8 per ton in 2026-2030. In accordance with the Environmental Code, part of the quotas allocated for GHG emissions will be sold through auctions of the Ministry of Ecology, and free quotas will be reduced by 3-5% annually. All of this provides a legislative basis for the development of CCUS technologies. However, given the capital cost of construction, additional financial incentives may be needed.

Commercial CCUS facilities around the world, 2018-2021



Capacity of existing projects 2021



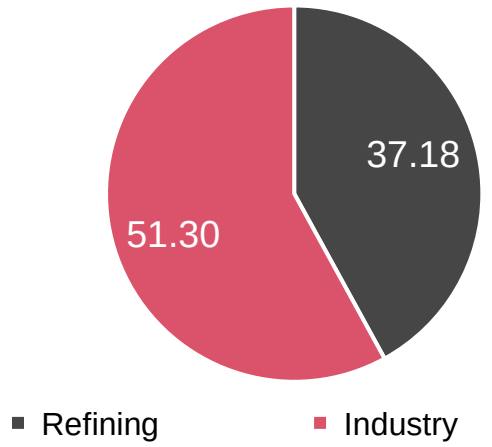
Source: IEA, open sources

Unlocking hydrogen potential in Kazakhstan

Hydrogen is a versatile energy carrier that can help decarbonize sectors of the economy traditionally closely associated with the use of fossil fuels (steel production, long-distance transportation, etc.). Hydrogen can also be used as an energy storage or maneuvering power source to balance uneven RES generation.

- In 2020, 90 megatons of hydrogen were produced, most of which was used in the oil refining sector. All of the hydrogen was produced using fossil fuels without CCUS systems. The IEA predicts that global consumption will exceed 200 megatons of hydrogen by 2030.
- At this point, most countries around the world have strategies to develop the hydrogen industry, especially low-carbon hydrogen, or have announced their intention to do so. Canada plans to co-fire hydrogen with natural gas to decarbonize the heating sector. Japan is developing hydrogen fuel cell technologies for microgeneration and hot water supply.

Global hydrogen use, 2020 (megatons)



There are no commercial projects for the use of hydrogen in Kazakhstan, but there are plans for its development. KazMunayGas plans to use hydrogen to decarbonize trucks and locomotives. A Green Hydrogen Alliance has also been created, with the participation of technology companies from Germany, Italy, Spain and Kazakhstan.

Kazakhstan has the potential to develop hydrogen production. France and Germany are already exploring regions for major projects. The possibility of further exports to European countries is also being considered. The Hydrogen Development Strategy is expected to be adopted.

Source: IEA, open sources

Hydrogen use will help reduce GHG emissions in the energy sector

Hydrogen plays a big role in decarbonization of the energy sector, in particular, electricity generation. It can be used in several ways in the energy sector.

Co-combustion of ammonia in coal-fired power plants

Co-combustion of coal with a 20% share of ammonia in coal-fired plants can reduce GHG emissions by up to 5 times, using low-carbon hydrogen. This ratio does not require significant modernization of the plants.

Hydrogen/ammonia as a fuel for gas turbines

Most existing gas turbine designs can already operate with hydrogen fractions of 3-5%, and some can with fractions of 30% or higher. However, this requires modernization of the turbines. Hydrogen can be a source of maneuverable generation, which is lacking in the RoK for full-scale deployment of RES.

Hydrogen fuel cells

Can also be used as a source of maneuverable generation. Suitable for standby or distributed generation. In addition to electricity, it generates heat and hot water, which is an opportunity for decarbonization of the heating sector.

Long-term energy storage system

Optimal for storing energy for 25-40 hours, which makes the main advantage over lithium-ion batteries. However, up to 60% of the energy is lost during the conversion process.

> Hydrogen can become the basis of Kazakhstan's energy security in the future. Using the experience of European countries that have planned the transition of coal-fired power plants, it is possible to introduce pilot hydrogen projects in our country. Nevertheless, the initiative requires research and the creation of a favorable investment climate.
>
> **Ainur Sospanova**
>
> Chairman of the Board of the Association of Legal Entities "Qazaq Green Association"

Source: World Energy Council

There is a necessity to change the thinking about efficient energy systems

The energy transition poses new challenges for the energy system. It is necessary to introduce smart systems for managing electricity transmission and distribution networks

Problems of changing ES	Direction	Decision Smart Grid
Few large power plants	Electricity generation	A large number of small power plants
Centralized, state-owned electricity market	Energy market	Decentralized international market
Based on large transit energy networks	Electricity transmission	Based on small grids and regional coverage of demand gaps
From producer to consumer	Electricity distribution	In both directions
Passive consumption, consumption fee only	Electricity consumption	Active participation, trade in surplus electricity

The transition to a decentralized energy market based on distributed generation will increase the country's energy security and the efficiency of the energy system

Source:Heinrich-Böll-Stiftung, open source

Energy Efficiency and Smart Grid Implementation Are Necessities for the Energy Transition (1/2)

Rising fuel and electricity prices make energy efficiency and Smart Grid deployment an optimal energy transition and energy saving solution. The IEA predicts that at least 4% annual improvement in energy efficiency is required to achieve Net Zero.

During the survey, respondents were asked to assess the need for state regulation of energy efficiency and the introduction of Smart Grid.

84% State regulation of energy efficiency requirements is required

66%

Full implementation of the Smart Grid in Kazakhstan is a prerequisite for the energy transition

68% The low level of automation and digitalization in the power industry significantly reduces the investment attractiveness and accuracy of its regulation

60% ESOs should not be tied to a specific region and should provide their services throughout the country through digital technologies

“

Insulated housing and ability to regulate energy consumption, will allow people begin to consume less. This already makes it possible to modernize heating networks at a lower cost, and further significantly reduces the number of required heat generation stations. Therefore, the approach to modernization should be comprehensive.

It is also necessary to return to the consideration of the project for the installation of individual heating points. For example, consumption in houses without IHS is 0.328 Gcal per square meter, while for IHSs it is 0.242 Gcal per square meter. Thus, the savings are about 26 percent. True, in this case, the installation of an ITP will be expedient only with a major renovation of houses. In any case, the investment attractiveness of thermal power engineering is impossible without putting things in order in the housing and municipal services.

Zhakyp Khayrushev

Expert in the field of electric power industry, Honored Power Engineer of Kazakhstan

Energy Efficiency and Smart Grid Implementation Are Mandatory Conditions for the Energy Transition (2/2)

> The first steps to improve energy efficiency should be measures to reduce heat losses and increase the energy intensity of industry, because the greenest kWh of electricity is considered to be the kWh that was not consumed. Energy conservation and energy efficiency are at the core of any decarbonization policy. Efforts to transition to a carbon neutral economy should be split between energy efficiency and the introduction of capacities and new technologies in an 80/20 ratio.

Ainur Sospanova,

Chairman of the Board of the Association of Legal Entities "Qazaq Green Association"

> In recent years, renewable energy has been considered the newest trend in the electric power industry, but it is gradually leaving the sphere of "revolutionary" changes, turning into the main direction of the industry's development. Following the wave of renewable energy development, the situation began to change very quickly: new segments appear in the electric power industry.
>
> In order to introduce the technologies, it is necessary to:
>
> - Consider the possibility of making changes to the "Digital Kazakhstan" program in terms of introducing the "Internet of Energy" in the country.
> - Taking into account a possible increase in the tariff for organizations in the electric power sector, it is mandatory to include elements of "smart" networks, a "smart" substation in the investment programs of companies.
> - On the basis of one of the enterprises of electric networks, to conduct a pilot project under the state program "Digital Kazakhstan", which will allow to work out all the nuances of this program and, therefore, possible replication to other electric power facilities.
> - Expansion of ongoing measures for the implementation of AMR systems by including the relevant costs in the tariff of energy organizations.

Zhakyp Khayrushev

Expert in the field of electric power industry, Honored Power Engineer of Kazakhstan

Elements of Smart Grid technologies have been introduced already

Completed projects

Substation automation. Integration into a single system of autonomously operating equipment at each of the two levels of automation: digital protection and control of connections, substation control system

SCADA/EMS. Electrical network management system

Automated system of commercial electricity metering (ASKUE). ASKUE is a software and hardware complex that provides the collection and processing of information on electricity flows, the calculation and storage of parameters for a given period of time, as well as the transmission and display of information

Electricity trading system. Supply and installation of an electricity trading system on the Spot Market of Kazakhstan. Advantages: the ability of the system to evolve, the flexibility of customization, ease and reliability in operation

Current projects

The implementation of the project "Automation of the management of the modes of the Unified Electric Power System of Kazakhstan", included in the state program "Digital Kazakhstan", and consisting of three components has begun:

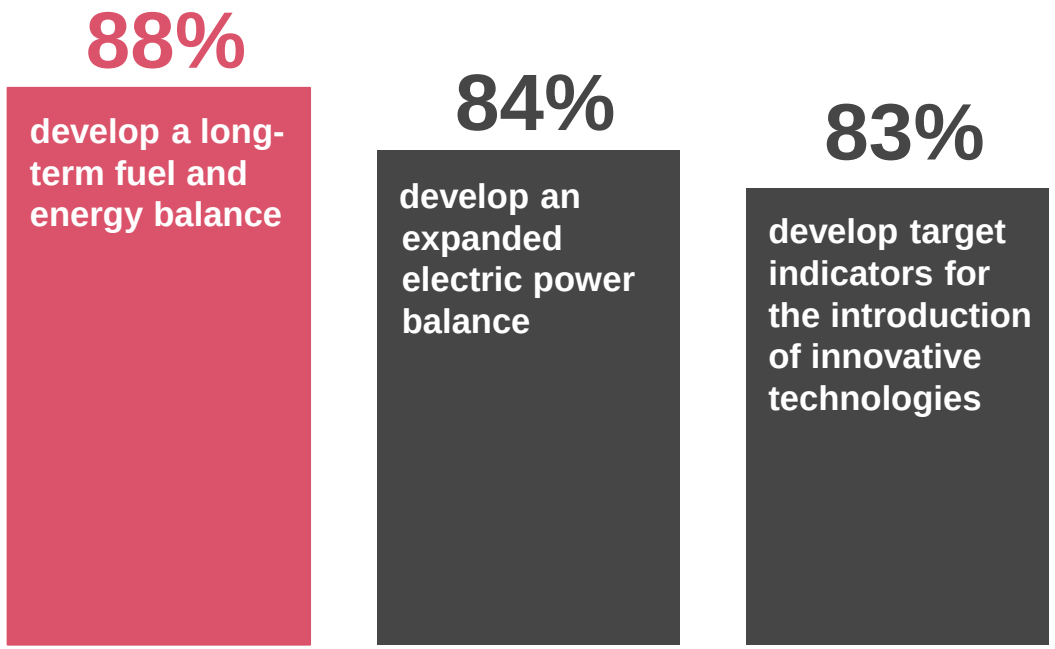
- Automatic Load-Frequency Control (ALFC);
- Centralized system of emergency automatics (CSPA);
- Synchrophasor technologies based on WAMS/WACS.

A pilot project for a digital substation is also being developed.

Source: KEGOC JSC

It’s necessary to develop strategic documents that will reflect the official long-term commitment to development of the economy and energy sector

Kazakhstan has adopted a number of strategic documents regarding development of the energy sector. However, these documents do not reflect current circumstances. In this regard, the respondents were asked to **assess the need** for more comprehensive strategic documents.



“Kazakhstan needs a single document that will set target indicators for the development of the electric and thermal power industry with the necessary volumes of investments, reforms, and which will allow defining its strategies for the development of industry and the economy.

Ainur Sospanova

Chairman of the Board of the Association of Legal Entities "Qazaq Green Association”

“Today, a new era has begun in the electric power industry, “Era of Low-Carbon Development”, which implies a move away from traditional coal and gas generation and a reduction in harmful emissions into the atmosphere.

New realities create the need to form a strategy for the future of electric power industry until 2050, taking into account carbon neutrality and sustainable development, with the participation of the energy sector.

Zhakyp Khayrushev

Expert in the electric power industry fielnd, Honored Power Engineer of Kazakhstan

Energy initiatives are a necessity in all areas of public policy

In recent years, a lot of work has been done in Kazakhstan to create favorable conditions for the development of RES, which clearly shows the growth in electricity generation from RES.
However, the energy transition and ensuring the energy security of the country require significant reforms and changes in public policy and regulation in the energy and related sectors.

Public-service sector

- Thermal insulation of buildings
- Minimum Energy Performance Standards (MEPS) and building codes
- Energy Efficiency Certification
- Energy Efficient Lighting

Transport sector

- Tax policy for transport
- Norms and labeling of fuel efficiency of passenger cars
- Fuel efficiency standards for heavy vehicles
- Public transport and energy-saving modes of transportation

Tariff Policy

- Tariffication of utility services taking into account real costs
- Energy efficiency directives from regulators
- Voluntary Energy Efficiency Programs

Legislation

- Favorable regulatory framework
- National Strategies, Plans and Goals
- Relevant agencies for energy efficiency
- Data, statistics and estimates

Business

- Rational energy use
- Commercial buildings
- Capacity building
- Small and Medium Enterprises (SMEs)
- MEPS for industrial equipment
- Manufacturing innovation

Financial sector

- Credit financing with the participation of the state
- Public-private financing
- Financial guarantees, risk sharing
- Fiscal Policy: Benefits, Discounts
- Government subsidies
- Funding from international climate investment funds

“

It is not only necessary to improve legislative but also policy in relation to energy. The developed documents do not provide a clear and complete picture of how the sector should develop. RES target indicators, the Strategic Development Plan of Kazakhstan, the Decarbonization Strategy until 2060, the Energy Balance until 2035, as well as other strategic documents have different goals and conclusions. Electric power industry is the basis of the economy, so it is very important to determine the exact volume of investments, growth points in the regions, and the need for infrastructure development.

Ainur Sospanova

Chairman of the Board of the Association of Legal Entities "Qazaq Green Association”

Research findings (1/2)

The ongoing energy crisis is the result of many interconnected events that took place over several years. Clearly, not all events and their consequences could be foreseen.

A major contributor was the strengthening of the climate agenda in Europe over recent years, which has led to the closure of coal mines, a reduction in fossil fuel and nuclear generation, and an increase in capacity from renewable energy.

Additionally, the COVID-19 pandemic which contributed greatly to the oil market crash (falling demand and oversupply), the unusually cold winter of 2020-2021 in Asia and Europe (the two main markets competing for LNG), and problems with loading capacity caused by the pandemic, increased gas demand. As the lockdown eased, higher economic activity increased the demand for electricity from business.

Abnormal weather conditions in 2021, which reduced wind generation in some parts of Europe, and only partially filled gas storage containers at the end of 2021, coupled with Russia's refusal to increase gas supplies to Europe, exacerbated the situation. The war in Ukraine was the tipping point, severely disrupting supply chains and limiting Russia as a supplier country.

The ongoing crisis allow us to draw several important conclusions regarding the country's energy security and these include:

- The necessity to consider climate risk (drought, cold, no wind) when designing and deploying renewable energy facilities, especially hydro and wind generation;
- The necessity of reserve capacity to provide energy security (including gas reserves);
- The global trend to reduce dependence on imported fossil fuels and diversify sources of supply.

Kazakhstan must consider experience in other parts of the world (e.g. a severe drought in 2021 in Latin America, a sharp decline in coal imports from Australia to China, a decrease in coal production in China due to the green agenda, a cold winter in Europe 2021-2022, the conflict in Ukraine) when developing the energy transition plan.

Research findings (2/2)

The level of explored reserves of coal, and the low cost of coal as a fuel, gives Kazakhstan some security. However, the age of generating facilities, and a significant change in the investment climate in favor of low-carbon development, clearly points to the need to steadily move away from coal.

Kazakhstan has announced its intention to achieve carbon neutrality by 2060. The RES sector shows steady growth (3.7% share of RES in the total volume of electricity production in 2021, 4.24% in the first half of 2022) and a high level of investment over the past few years (103.8 billion USD dollars in 2021). However, the pace needs to accelerate significantly.

There is an urgent need to transform the system of energy regulation and tariff setting to improve energy efficiency, phase out coal and upgrade the technological base.

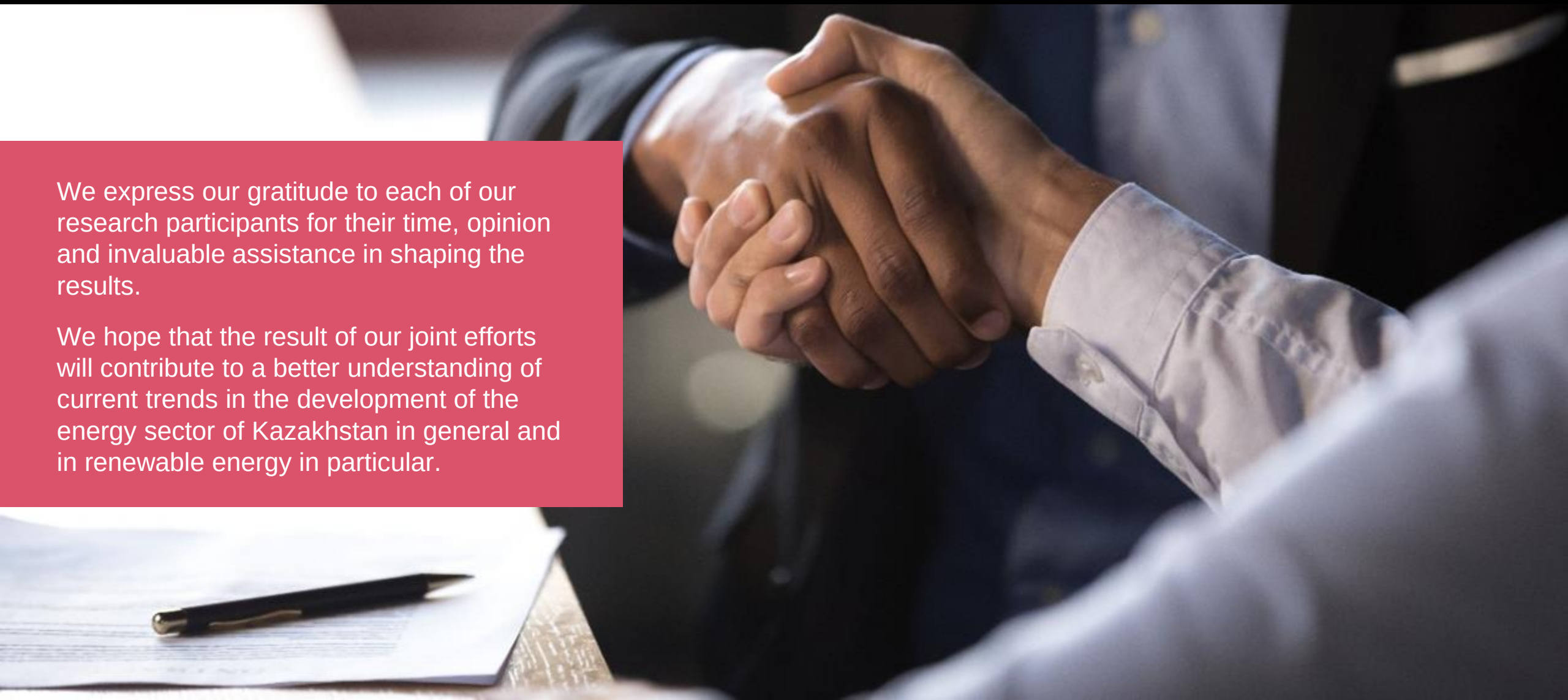
Overall, reaching the targets for renewable energy requires significant additional support from government including further development of the legal framework, strong relationships with international partners and investment in new technologies for clean energy.

> “
>
> ... the market has formed a clear request for the creation of a comprehensive energy development strategy. The state needs to respond to this request as soon as possible and create a framework that will not allow reactive changes in legislation and create favorable investment conditions.
>
> **Ainur Sospanova**
>
> Chairman of the Board of the Association of Legal Entities "Qazaq Green Association”

Glossary

- RES - renewable energy sources
- HPP - hydroelectric power plants
- COP26 - 26th United Nations Climate Change Conference
- NDC - Nationally Determined Contribution
- Net Zero - net zero emissions
- IEA - International Energy Agency
- EU - European Union
- LNG - liquefied natural gas
- M&M - Metals and Mining
- CO2 - carbon dioxide
- Smart Grid - smart power supply networks
- CCUS (Carbon capture, utilization and storage) - carbon capture, use and storage
- CN – Carbon neutrality
- GHG - greenhouse gases
- PS - power system
- SCADA / EMS - Supervisory Control And Data Acquisition/ Energy Management System
- WAMS/WACS - Wide Area Management System/Wide Area Control System (Transient Monitoring System/Transient Control System)
- CHP - combined heat and power plant
- UNDP - United Nations Development Program
- GW (Gigawatt) is a multiple unit of power equal to 10^6kWh.
- MBTE (million British thermal units) - a unit of heat energy
- GDP - gross domestic product
- ESS - energy storage system
- GTU - gas turbine plant
- GPU - gas piston unit
- CCGT - combined cycle power plant
- ETS – Emissions Trading System
- FSC – Financial Settlement Center for the Support of Renewable Energy Sources LLP
- EPO – energy producing organization
- ESO – Energy supplying organisations

Thank you



We express our gratitude to each of our research participants for their time, opinion and invaluable assistance in shaping the results.

We hope that the result of our joint efforts will contribute to a better understanding of current trends in the development of the energy sector of Kazakhstan in general and in renewable energy in particular.

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