International Energy Agency

Co-funded by the European Union

Uzbekistan 2022

Energy Policy Review

International Energy Agency

International Energy Agency

Co-funded by the European Union

Uzbekistan 2022

Energy Policy Review

International Energy Agency

INTERNATIONAL ENERGY AGENCY

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 31 member countries, 10 association countries and beyond.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea
Lithuania
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA

IEA association countries:

Argentina
Brazil
China
Egypt
India
Indonesia
Morocco
Singapore
South Africa
Thailand

International Energy Agency
Website: www.iea.org

Foreword

Uzbekistan is one of the focus countries of the EU4Energy programme, which is being implemented by the IEA and the European Union along with the Energy Community Secretariat and the Energy Charter Secretariat. The EU4Energy programme includes Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. It was designed to support the goals and aspirations of its 11 focus countries to implement sustainable energy policies and foster regional co-operation on energy sector development. One of the key ways the programme does this is by conducting in-depth policy reviews of individual countries, updating and extending the analysis contained in the IEA 2015 regional review, *Energy Policies Beyond IEA Countries: Eastern Europe, Caucasus and Central Asia*.

Uzbekistan embarked on broad-based reform of the energy sector in 2019 to transition from the government-owned and -operated and subsidised energy sector model to competitive gas, oil and electricity markets with significant private-sector participation and cost-covering energy prices. The withdrawal of subsidies should, however, be accompanied by support measures for the country's economically vulnerable citizens. Such a transition would attract new market entrants and new investments, including to develop Uzbekistan's significant solar and wind energy resources. These measures would also help limit greenhouse gas emissions and air pollution. Uzbekistan has major potential to increase the efficiency and diversity of its domestic energy supply and use. The IEA strongly encourages the government to intensify its efforts to implement its broad and ambitious energy reform agenda.

This in-depth review aims to guide Uzbekistan in its energy sector reforms and help it achieve its energy policy goals, including the provision of affordable, secure and clean energy to its population.

ENERGY INSIGHTS

ENERGY SECURITY

ENERGY SYSTEM TRANSFORMATION

ANNEXES

LIST OF FIGURES, TABLES AND BOXES

Figures

Tables

Boxes

1. Executive summary

This first comprehensive review of Uzbekistan's energy policies by the IEA comes at time of critical importance for the country's energy sector. The broad-based reform of the energy sector, beginning in 2019, has continued at a steady pace. Its reach and scope are ambitious by international comparison, and the IEA applauds the government of Uzbekistan for the progress made to date.

The energy reform is part of the government's broad structural and institutional reform package, introduced by President Shavkat Mirziyoyev, which aims to modernise Uzbekistan's economy and society and bolster long-term growth through increased efficiency and productivity. The energy reform is being implemented in phases over the next few years. It is covered in more detail in the individual chapters of this report.

Starting from a largely closed and monopoly-driven energy system, the reform has led to concrete steps to harness market forces to attract investments, increase transparency and rule of law, improve energy security, and strengthen the environmental sustainability of the energy sector. At this stage, the country's energy sector remains dominated by state-owned enterprises. An important area of reform is to improve the corporate governance of these companies. At the same time, the sector needs to be brought to financial viability, for example through debt restructuring and with measures to avoid debts from reaccumulating.

Uzbekistan has major potential to increase the efficiency and diversity of its domestic energy supply and use. Key to realising this potential is a gradual transition to competitive markets with significant private-sector participation and energy prices that reflect the full cost of supply. The IEA therefore strongly encourages the government to intensify efforts to increase competition and attract private investment to build new and modernise existing infrastructure. Reforming the tariff system and phasing out gas subsidies to enable cost recovery and fair competition across power and heat technologies is essential. This is a complex task that requires careful attention to protect vulnerable consumers to ensure a socially acceptable reform. It also requires continuous efforts to ensure sufficient planning capabilities and skills, including through education and training, and to improve public awareness of the reasons for energy policy changes and the benefits of future reforms.

A reform for a more efficient, dynamic and sustainable energy system

A critical issue is how to increase efficiency, attract investments and new entrants, and diversify energy supply in Uzbekistan's current energy system in which gas, electricity and heat are supplied by financially burdened monopolies at strongly subsidised prices. The policy response should include energy tariff reform, electricity and gas market reform, increasing the use of renewable energy, and improving energy efficiency. Encouragingly, this is what Uzbekistan's energy reform promises to deliver.

The level of energy prices is central for attracting investment and for encouraging citizens to use energy efficiently. As part of the country's social policy, the government sets end-user prices for electricity and natural gas below full costs of supply. The IEA estimates that in 2020, Uzbekistan's implied subsidies on natural gas, electricity and oil amounted to USD 3.8 billion, or 6.6% of the country's gross domestic product (GDP).

The low price of natural gas in particular creates distortions. For example, it discourages using renewable energy for electricity and, as it favours individual gas boilers for space heating, it discourages potentially more efficient system solutions including the combined generation of district heating (DH), cooling, electricity and the use of heat pumps. Retail oil prices were deregulated in 2020.

Subsidised tariffs do not encourage residential and industrial consumers to improve energy efficiency, even though it would make economic sense for the country as a whole. A tariff reform should be placed at the heart of Uzbekistan's efforts to reform its energy sector. Natural gas could be saved through improved efficiency, substituted with renewable energy in power generation and turned into higher-value-added petrochemicals. The greenhouse gas (GHG) emissions avoided would help the country meet, and in due course raise, its climate target under the Paris Agreement. While climate policy is not a priority in Uzbekistan's energy sector plans, as the government focuses on security of supply and economic growth, using gas, coal and oil more efficiently would also reduce GHG emissions and local air pollution.

In order to reduce subsidies in the longer term, more importance should be given to communicating to the public that energy subsidies are a highly regressive policy measure, benefiting mainly the well-off. The subsidies should be phased out gradually and accompanied with support mechanisms to cushion the effect on vulnerable groups.

Natural gas and oil

Natural gas dominates Uzbekistan's energy supply. In recent years, it has provided around 85% of both total energy supply and electricity supply and is the main energy source in all sectors. It has also been a major source of export revenue, but the government now plans to stop exports by 2025 and use the gas for petrochemicals production and domestic energy supply. At the current rate, however, the country's gas reserves will be depleted in less than 20 years, while the government foresees natural gas demand to rise by 30% to 65 billion cubic metres (bcm) by 2030.

Uzbekistan has adopted legislative incentives to attract foreign investment to maintain production as well as to develop new oil and gas fields to meet a growing domestic demand. To encourage the necessary investments, it intends to gradually raise the very low gas tariffs to cost-recovering levels. Oil prices were deregulated in 2020, and a full gas price deregulation is planned for 2026. A gas tariff reform would encourage both more efficient gas use and the development of the country's significant solar and wind power potential for electricity generation. It would also increase the financial viability of the sector, which needs investment in modernising gas pipelines, for example. Efforts to modernise and increase oil refining and petrochemicals production are proving successful. The state-owned Uzbekneftegaz was unbundled in 2019, and the government has launched a programme to partly privatise its holdings in the sector in the coming years.

Electricity market reform

Electricity demand in Uzbekistan is set to grow in the coming years and decades. The government expects it to roughly double to 2030. The whole population has access to affordable electricity, and growing electrification is set to increase demand from the current low level of supply of around 2 000 kilowatt-hours (kWh) per capita per year. Investments are required in new and more efficient generating capacity and electricity grids. The country needs a more flexible and secure dynamic electricity sector, and the IEA welcomes the government's determination to reform the electricity system and gradually move from a state-dominated vertically integrated system to a more dynamic, efficient and environmentally sustainable one. The challenge now is to follow on the reform path and deliver the transformation.

The need for electricity reform is recognised in Uzbekistan's Green Economy Transition Strategy for 2019-2030 (from 2019) and the Security of Electricity Supply Concept for 2020-2030 (from 2020). Several proposals have been drafted, including the draft law on electricity, the electricity network code and the presidential decree on further electricity market reforms. A well-structured three-stage reform plan exists for a transition to a competitive electricity market, but its implementation is largely yet to begin.

The IEA urges the government to adopt the pending legislation and to implement ambitious electricity market reforms for the benefit of the country and its economy. International experience suggests that reform approaches should be shaped by a country's specific political and economic context, be tailored to achieve desired policy outcomes, and offer multiple institutional pathways to achieve these desired outcomes.

Uzbekistan's energy reform is fundamentally changing the electricity sector, which was built on the monopoly of the state-owned Uzbekenergo. The monopoly has already been divided into separate companies for transmission, distribution and thermal power generation.

The government should first focus on governance issues and financial viability. Tariffs and subsidies should be revised to enable full cost recovery, and to encourage investment in power sector development. Reforms of this kind should help reduce operating costs and improve generation, transmission and distribution efficiency. It is therefore encouraging to see the government's May 2022 proposals for revised tariffs. When implemented, they are an important step in the direction of full cost recovery and a manifestation of rational economic policy.

Specific policy objectives should also be set for a secure, efficient and clean electricity system. Although Uzbekistan has large gas resources to generate electricity, it is also in the enviable position of having excellent solar and wind power potential. Technology costs for solar and wind have declined dramatically over the past decade, making it more inviting for the country to tap into their potential and save more natural gas for petrochemicals production, for example. To enable the energy sector to allocate resources more efficiently, the IEA urges the government to also reform and gradually abolish subsidies for natural gas in electricity generation.

At the same time, diversifying electricity generation to include more renewable energy would help limit carbon dioxide (CO_2) emissions and air pollution. In this context, the IEA welcomes the government's plans to raise the share of renewable energy in total electricity supply from

7.5% in 2020 to 25% in 2030. The significant solar and wind power resources are being developed, as international investors have responded positively to the tenders for capacity and signed power purchase agreements (PPAs) for power generation. The government also has plans to build the country's first nuclear power units, with Rosatom, but it is not clear whether and when this project would be realised. Recent international experience has shown a real risk of major delays and cost overruns in large nuclear power projects.

The IEA supports the government's plan to open up electricity generation to competition, and create wholesale and retail markets. This is best done gradually. The first steps should be to remove entry barriers for new participants and to transition towards unsubsidised cost-based economic dispatch of power plants to increase efficiency. This is already being done through tenders and gradual electricity tariffs increases.

To increase competition, the government should consider privatising some of the state-owned generating assets. Emphasis should be on privatisation as a potential means to increase competition and operational efficiency rather than as an end in itself, and full privatisation will probably not be necessary to achieve the desired goals. For example, in many European countries, the state remains the majority shareholder in electricity generators that operate in competitive wholesale markets. New entrants could also be entirely private or based on public-private partnerships, as long as market entry barriers are removed. An important point to consider relates to increasing the share of variable solar and wind power capacity. If the government plans to attract more investment through long-term PPAs, a mechanism should be designed to integrate such PPAs into the future wholesale market.

Gains from more efficient generation and grid operations would limit the need to raise end-user prices, and in any case social policy measures could be targeted to vulnerable customers. Network operations need to be remunerated sufficiently to enable the transmission system operator (TSO) and the distribution system operator (DSO) to modernise, maintain and, in light of rising electricity demand and solar and wind power generation, expand the networks.

A major necessary step in Uzbekistan's electricity market reform will be the establishment of a market regulator. This should be done without delay. The more independent the regulator, the better for the market participants and, eventually, the customers. It will be essential to grant the future market regulator the legal right to take binding decisions and issue recommendations.

Securing a growing electricity supply

An uninterrupted supply of electricity is critical to a modern society. Following several cross-border blackouts over the past two years, it is also a focus area for improvements in Uzbekistan and the broader Central Asian region.

In their efforts to ensure electricity security, many IEA member countries have found it useful to introduce a comprehensive framework, supported by a set of laws, regulations, policies and measures, to address the challenges for generation, transmission, distribution and supply. The IEA urges Uzbekistan to consider a similar framework approach. The government should also carry out emergency response exercises, as they have proven to be effective in other countries at boosting preparedness and response capability.

An electricity security framework should include clear targets covering fuel security, resource adequacy, operational security and governance. It should also include indicators to measure progress. Uzbekistan's fuel/energy source security is becoming fragile, as the demand for the country's natural gas resources, the main energy source for electricity, is growing fast in other sectors, too. The plans to diversify into solar and wind power generation, possibly also nuclear power, appear well-founded also from the security of supply angle. The country needs more power plants, and several solar and wind power projects are under way. Efforts to modernise and expand Uzbekistan's electricity networks need to be intensified and supported with measures to ensure the financial capacity for network maintenance.

The government should assess electricity infrastructure needs and prepare long-term network development plans, also in the cross-border context with neighbouring countries. It should also ensure that it has sufficient people with the expertise necessary for this important task.

Using energy more efficiently

Energy consumption per capita is low in Uzbekistan, around one-quarter below the world average. At the same time, the country's economy remains one of the most energy-intensive in the world, with energy consumption per unit of GDP more than 50% above the world average.

As is the case for other countries with legacy infrastructure and subsidised energy prices, Uzbekistan has plenty of opportunity to improve energy efficiency. The IEA strongly encourages the government to consider energy efficiency as a source of revenue, clean air and jobs, and to adopt without delay laws, strategies, policies and measures to help realise the potential it offers.

Key influencing factors for energy efficiency in Uzbekistan are subsidies and pricing mechanisms notably for natural gas, the main energy source in all sectors. While reform efforts are under way, experts broadly agree that current pricing structures limit incentives for energy efficiency improvements across key sectors of the economy, particularly in buildings and industry.

Instead of subsidising energy use for everyone, the government should target social policy measures to those in real need and also consider gradually switching to supporting more efficient use of energy. For example, it could launch programmes to replace the highest-consuming household appliances (refrigerators, washing machines, etc.) with highly energy-efficient new models. As low energy prices have been seen as a form of social policy, these programmes could target the less well-off.

The case for introducing financing mechanisms for efficient housing is strong. Renovation of the existing building stock, especially residential and public buildings, would save energy and bring health benefits and would help offset the impacts of tariff increases. The government should also ensure that residential buildings will comply with future energy efficiency regulations. In many IEA countries, compliance is verified by public-sector building inspectors, and the government should consider this approach.

There is also a strong case for a perspective beyond 2030. In the coming years and decades, more buildings will be constructed, more appliances and equipment sold, and

more vehicles bought. Strong policies on energy efficiency will become all the more relevant, and a long-term approach is needed to guide the country on an environmentally sustainable path.

Experience in IEA member countries shows that minimum energy performance standards (MEPS) are among the most effective and cost-efficient energy efficiency policy instruments. Uzbekistan introduced MEPS for appliances and equipment in 1997, and the IEA encourages it to intensity MEPS use and expand it to other sectors, such as transport. MEPS use should be underpinned by implementing an effective mechanism for energy efficiency audits.

The population of Uzbekistan, around half of which still lives in the countryside, is set to continue to grow, urbanise and become wealthier. The country needs to build more urban infrastructure over the coming decades, including new heating solutions. Space heating is today based on subsidised gas used in individual boilers. However, modern district heating and cooling (DHC) systems, combined with electricity generation, heat pumps, waste heat use and thermal storage, could offer a solution that is more efficient and cost-effective while helping to reduce CO_2 emissions.

Uzbekistan's energy use decreased by 14% from 2010 to 2020 to reach 33 million tonnes of oil equivalent (Mtoe). By sector, total final energy consumption (TFC) grew only in transport, by one-quarter. The private car fleet is expanding very fast, and although it is mostly fuelled by compressed natural gas (CNG), instead of oil, Uzbekistan should still avoid becoming locked into private car-dominated inefficient and energy-intensive urban structures. Public transport should be modernised and expanded ambitiously, and energy and climate aspects should be an integral part of long-term transport and urban development policies. For example, if private car ownership in Uzbekistan were to increase to today's average EU levels, the country's car fleet would grow fivefold, or by around 14 million.

Energy innovation merits more attention

Energy innovation is necessary to help Uzbekistan maintain and improve the competitiveness of its economy and to diversify it away from natural gas and other fossil fuels. The IEA encourages the government to significantly increase its efforts on energy innovation.

Further energy data improvements

Reliable data are the basis of sound policy making. The IEA commends the State Committee of the Republic of Uzbekistan on Statistics (UzStat) for improving energy data collection and monitoring, and it encourages UzStat to further develop national energy statistics to improve data coverage and quality and to inform policy decisions. To achieve this, it is critically important that the government provide UzStat with the necessary resources.

Key recommendations

The government of Uzbekistan should:

- Take the necessary action to finalise as quickly as possible the draft laws and plans currently under consideration to transition to competitive energy markets, and then ensure effective implementation on the basis of clearly set out responsibilities, accountabilities and adequate resources.
- As a matter of priority,
  - reform energy tariffs to reflect the full cost of supply and provide support only for the most vulnerable customers
  - introduce an independent and well-resourced energy regulator to ensure fair competition
  - address the financial imbalances in the state-owned energy companies and intensify efforts to avoid their re-emergence.
- Work ambitiously to increase the efficiency of energy supply and use and, in the anticipation of continuous growth in the country's urban population, incorporate energy and climate considerations into long-term urban development and transport plans to limit growth in energy demand.

2. General energy policy

Key data

(2020)

TES:

45.3 Mtoe (natural gas 82.7%, oil 9.5%, coal 6.4%, hydro 0.9%), +0.3% since 2010

TES per capita:

1.3 toe/capita (world average in 2019: 1.9 toe/capita)

TES per unit of GDP:

181 toe/USD million PPP (world average 2019: 114 toe/USD million PPP)

Energy production:

54.5 Mtoe (natural gas 90.5%, oil 5.8%, coal 2.6%, hydro 1.0%), +0.1% since 2010

TFC*:

33.1 Mtoe (natural gas 62.6%, electricity 13.5%, oil 11.9%, district heat 8.1%, coal 3.9%), -13.8% since 2010

*Official statistics for bioenergy consumption are not available.

Note on data quality: The IEA has received official energy statistics from Uzbekistan since 2018. The national data reporting has since been aligned more closely with the International Recommendations for Energy Statistics. As a result, the accuracy and disaggregation of the energy statistics has increased notably in recent years. However, the revised data may not be fully comparable with the historical figures, which may lead to unexpected trends especially on the demand side. The IEA continues to co-operate with UzStat to support improvements of the national official energy statistics.

Country overview

The Republic of Uzbekistan covers an area of 448 978 square kilometres (km^2). The territory is bordered by Kazakhstan to the north and west, by Kyrgyzstan to the east and Tajikistan to the south-east, and by Turkmenistan and Afghanistan to the south. Its permanent population in 2021 was 34.4 million, with 2.6 million residing in the capital, Tashkent, the largest city in Central Asia. Uzbekistan's population is growing at around 1.7% per year. Around 30% of the population are under 30 years old, while 10% are over 65. Roughly half of the people live in cities and another half in rural areas (Uzhydromet, 2021).

Most of Uzbekistan (about four-fifths) is occupied by plains, one of the main ones being the Turan Plain. The country's highest point (4 643 metres [m]) is in the Tien Shan and Pamir mountain ranges in the east/north-east, and northern/central Uzbekistan is the location of the Kyzylkum and Karakum deserts.

Primary sector products make up most of the country's exports, with the largest earnings coming from metals (gold, copper and zinc), cotton and natural gas. The country is also the fifth-largest uranium producer in the world.

In 2021, Uzbekistan's gross domestic product (GDP) in current prices amounted to UZS 735 trillion (USD 69 billion) – a 7.1% increase in real terms from 2020. GDP has grown robustly in recent years, including by 1.9% in 2020, the year when the global GDP declined (UzStat, 2022). GDP per capita was USD 1 983 in 2021. The World Bank expects GDP growth to slow to 3.6% in 2022 (World Bank, 2022).

Uzbekistan is undergoing structural, economic and political transformation. Various laws and regulations are relatively new and untested, which naturally affects the business climate of the country. The government continuously works on refining the business and investment climate of Uzbekistan through major reforms, including 1) simplification of licensing procedures (since 2017 more than 60 licensing procedures were abolished); 2) privatisation of various state-owned companies (by 2026, Uzbekistan plans to privatise around 600 state companies per the Strategy for 2021-2025 endorsed by the Cabinet of Ministers Decree No. 166 and separate Presidential Decrees [No. 6167 and No. 6096]); and 3) introduction of new legal concepts (for example, there are now legal mechanisms allowing initial public offerings, secondary public offerings, issue of bonds, creation of venture funds and others) (Uzbekneftegaz, 2021).

Since 2019, Uzbekistan is implementing large-scale reforms also to strengthen its energy sector. Reforms are necessary to address the need for infrastructure modernisation and expansion and more efficient energy supply and use.

Figure 2.1 Map of Uzbekistan

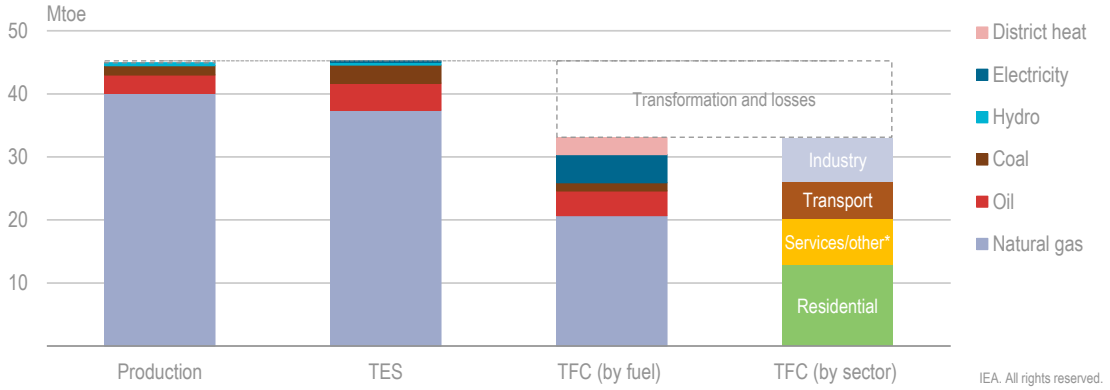
This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Energy supply and demand

Uzbekistan's energy production focuses on natural gas, but includes also oil and gas. Domestic production of gas is more than enough to satisfy the demand, but oil and coal are increasingly imported to cover their consumption. In 2020, the overall imports and exports were virtually on par for the first time. Fossil fuels historically account for nearly all of total energy supply (TES). Natural gas is the key energy source with 83% share of TES in 2020, followed by oil (9%) and coal (6%). The contribution of renewables (virtually all hydro) is currently modest, below 1%.

The share of natural gas in TFC (63%) is among the highest in the world (third in 2019). With around 50% share it is the main energy source even in the transport sector. The rest of TFC was covered by electricity (14%), oil (12%), district heat (8%) and coal (4%). The residential sector is the largest end user with a 39% share in 2020, followed by transport (22%) and industry (21%). The remainder was consumed mainly in services (13%) and agriculture (4%).

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



Uzbekistan's energy system is heavily based on natural gas.

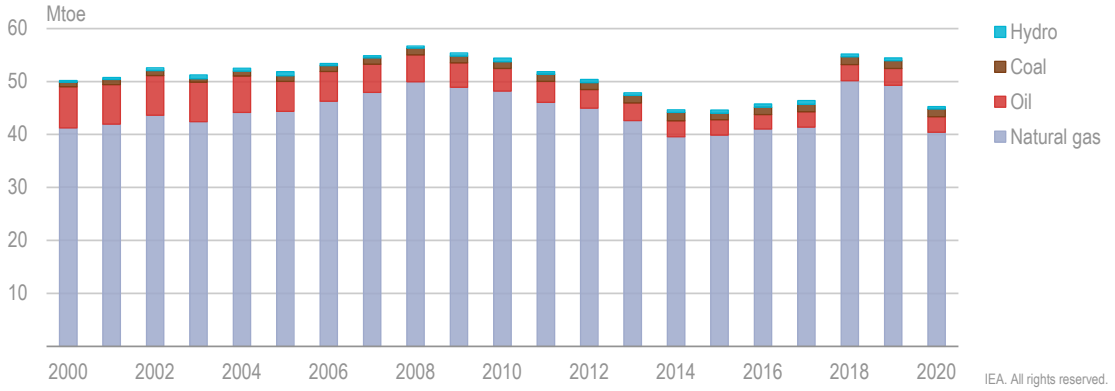
* Includes commercial and public services, agriculture and forestry.
Note: Bunker fuels of around 0.1 Mtoe are not included in TES.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Energy production and self-sufficiency

Domestic energy production in Uzbekistan is dominated by the extraction of gas, amounting to over 90% of the total energy production of 45 Mtoe in 2020. Production fell almost 20% from 2019 to 2020, or by over 10 bcm, mainly because of Covid-related demand declines in importing countries, in particular the People's Republic of China (hereafter, "China"). Oil production (6% of total) is on a gradual decline with an annual average decrease of 4.8% since 2000. Coal production is minor with only 3% of the total.

The share of renewables (virtually all hydropower) averages around 1% of the total production. The share is likely to grow notably in the coming years due to the planned solar and wind capacity additions. Solid biofuels are consumed in the rural areas, but their consumption has not been quantified.

Figure 2.3 Primary energy production by source, 2000-2020

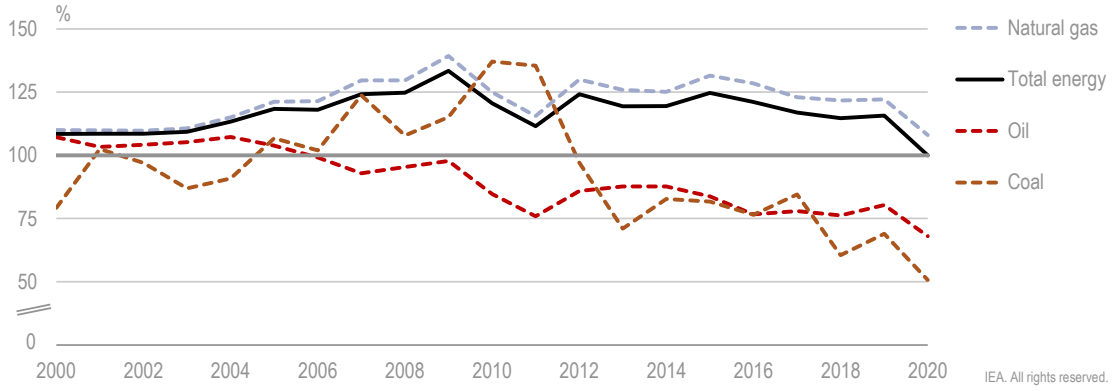


Uzbekistan mainly produces natural gas.

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

Until 2019, Uzbekistan's overall energy surplus (self-sufficiency) remained relatively stable, averaging 120% of TES needed to cover domestic demand in the last two decades. In 2020, energy imports and exports were on par due to a slump in natural as exports. Gas production still exceeded domestic demand, allowing for natural gas exports, whereas Uzbekistan became a net importer of oil in 2006 and that of coal in 2012.

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



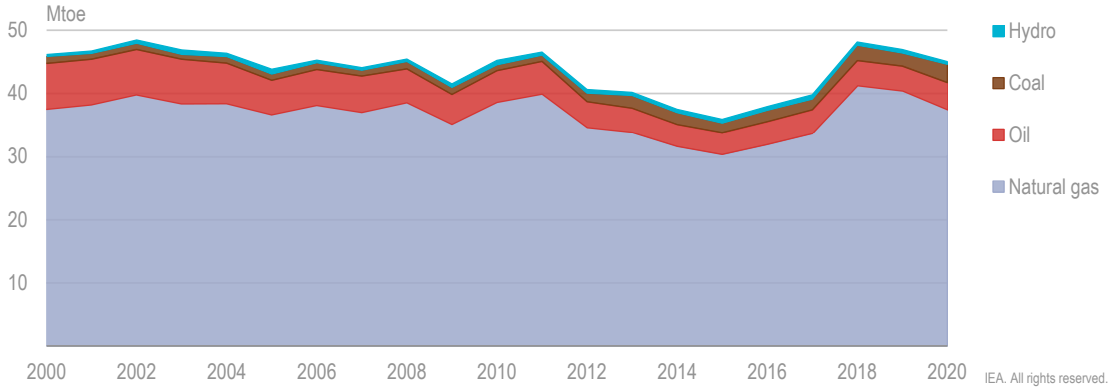
Uzbekistan has exported around 25% of its gas production but imports around 25% of its oil and gas demand.

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

Uzbekistan's TES stood at 45.3 Mtoe in 2020 (+0.3% since 2010). Natural gas accounted for 83% of TES, oil for 9% and coal for 6%. Renewables (mainly hydro) covered around 1% of TES. The share of fossil fuels is thus around 99% of TES (world average in 2019: 81%).

Natural gas forms the backbone of Uzbekistan's energy system, its share being stably above 80% of the total energy demand between 2000 and 2020. Oil demand has gradually declined (-24% since 2010) whereas coal consumption has more than tripled (+213%) in the same time period, albeit from a low base.

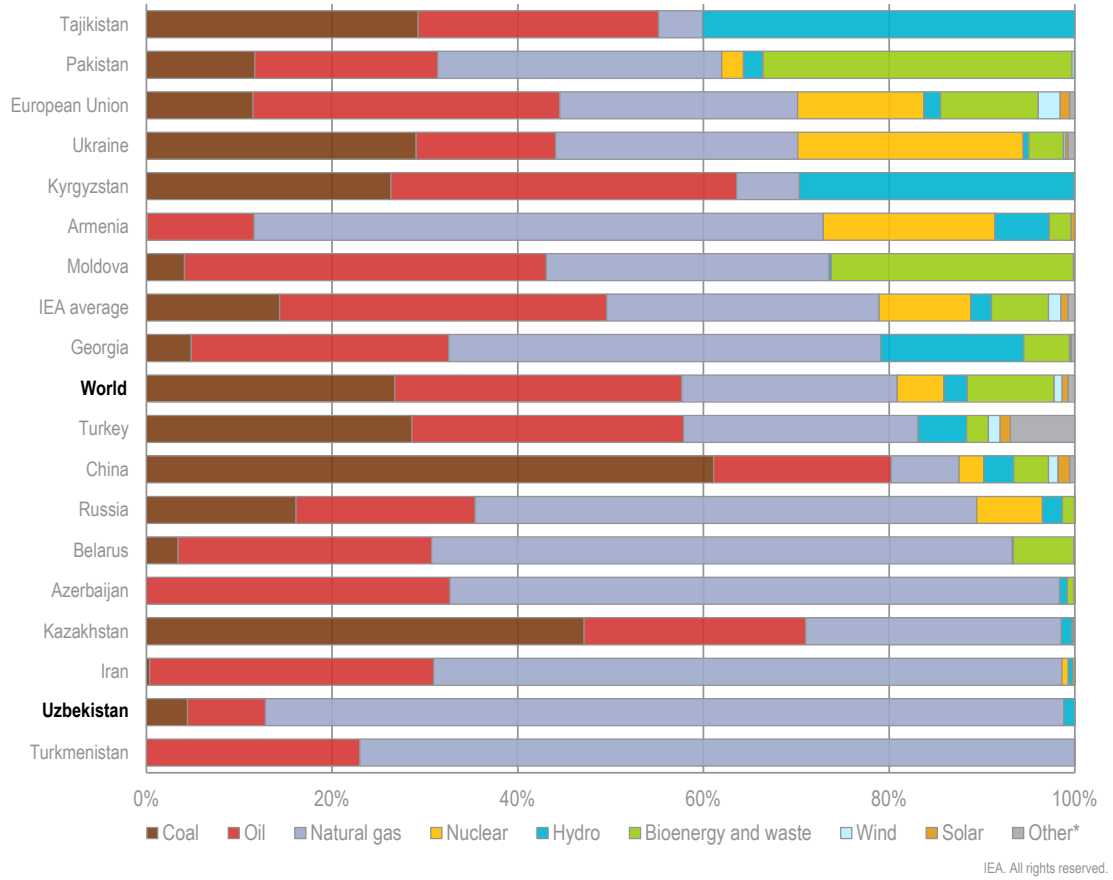
Figure 2.5 Total energy supply by source, 2000-2020



Natural gas dominates Uzbekistan's TES, with a share above 80%.

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

Figure 2.6 Breakdown of TES in selected countries, 2019



Uzbekistan's natural gas intensity of energy supply is among the highest in the world.

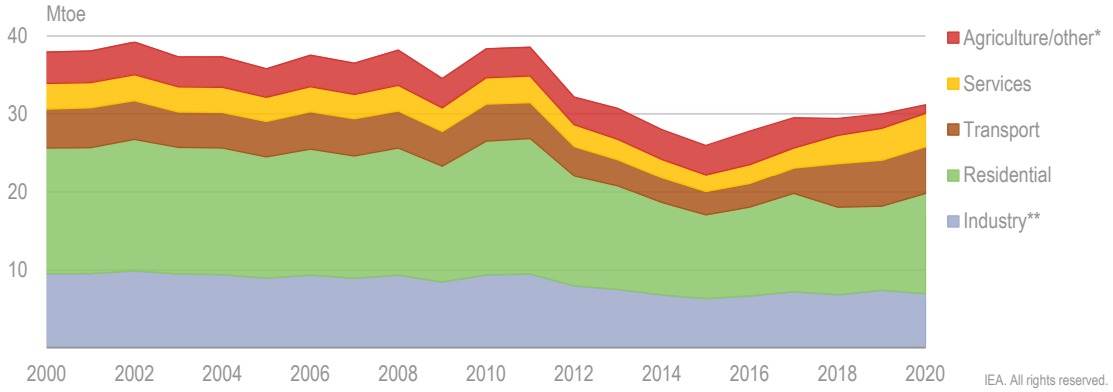
* Includes geothermal, primary heat, wave and ocean energy.
Note: Electricity trade not included.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Energy consumption

Uzbekistan's TFC amounted to 33.1 Mtoe in 2020 (-14% since 2010). The residential sector is the largest consumer with 39% share, although according to the available data, consumption has fallen 25% since 2010. Industry consumed 21% in 2020, down 26% from 2010. In contrast, consumption in the transport sector (18% of the total in 2020) has grown by 28%. Some of the alleged trends may result from improved statistical reporting in recent years and therefore should be treated with caution. The remainder of TFC, around 22%, was mainly consumed in services and agriculture.

With over 60% share of the TFC in 2020, natural gas is the main energy source in all sectors of the economy. This also includes transport, as most of the vehicle fleet in the country is fitted to run on CNG. Electricity (also mainly generated via natural gas) held the 14% share of the total in 2020. The share of oil was only 12% in 2020, followed by district heat (8%) and coal (4%). Direct use of fossil fuels accounted for almost 80% of the TFC in 2020.

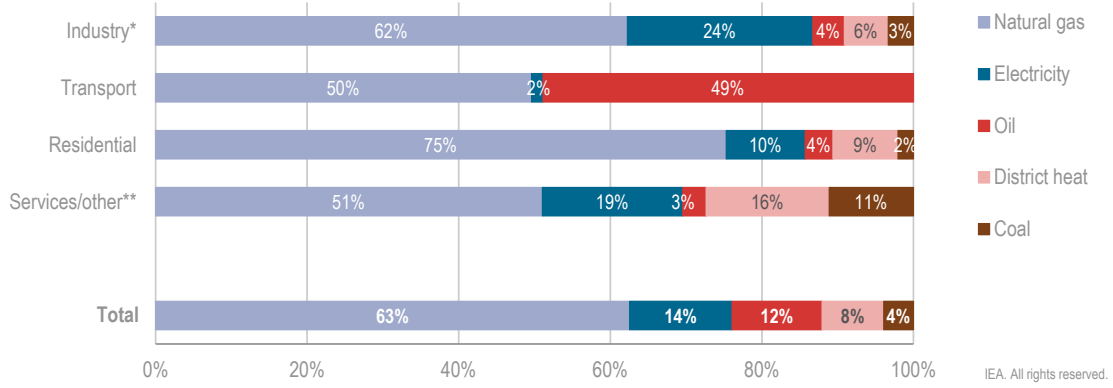
Figure 2.7 Total final consumption by sector, 2000-2020



Final consumption of energy has decreased over 20% since 2000.

* Includes agriculture and forestry as well as unspecified energy consumption (2% of TFC in 2019).
** Includes non-energy consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 2.8 Total final consumption by source and sector, 2020



Natural gas is the main energy source in all sectors of the economy.

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

Energy sector governance

The presidential administration, **Cabinet of Ministers** and **Ministry of Energy** (MoE) are the main government institutions in the energy sector, while individual subsectors are controlled by several state-owned enterprises.

Executive power of the Republic of Uzbekistan is held by the president, and the president assembles a Cabinet of Ministers to organise the work of the executive authorities. The Cabinet of Ministers is a superior executive body accountable directly to the president.

The legislative body of Uzbekistan is the National Assembly (Oliy Majlis), a bicameral parliament. The legislative chamber has 150 deputies elected from territorial constituencies. The Senate has 100 members, 84 elected from the regions, from the Autonomous Republic of Karakalpakstan and from Tashkent, and 16 nominated by the president of Uzbekistan. Both chambers have five-year terms.

The MoE, established in February 2019, is the central executive authority responsible for implementing state policy and the various regulations, orders and decrees issued by the government for the energy sector.

The MoE is responsible for regulating the production, transmission, distribution and consumption of electric and thermal energy and coal, as well as the production, processing, transportation, distribution, sale and use of oil and gas, and their products. Its main tasks are to:

- Regulate the energy sector.
- Implement production sharing agreements and supervise compliance.
- Attract private capital for the exploration and production of energy resources.
- Develop public-private partnerships.
- Improve the tariff policy to facilitate the formation of a competitive business environment, increasing and diversifying energy production.

The Ministry of Economic Development and Poverty Reduction (MEDPR) (formerly the Ministry of Economy and Industry) was established in March 2020. Its main objectives are to analyse and forecast macroeconomic indicators and development, based on proposed economic management market mechanisms and strategies to develop Uzbekistan’s main industries (including energy) given the state of the economy, the foreign market situation, and trends in the global and regional economy. It also formulates strategies (models) for the country's industrial development based on the effective deployment of production forces, rations and food production.

The Ministry of Innovative Development, established in November 2017, primarily aims to develop and implement innovations in state and public construction, taking into account long-term scenarios of the country's development; define the state’s scientific, technical and innovation policy priorities; and approve state scientific and technical programmes for fundamental, applied and innovative research.

The Ministry of Finance leads the work of the Interdepartmental Tariff Commission under the Cabinet of Ministers, established in 2018, which determine energy tariffs. The ministry’s PPP Development Agency develops public-private partnerships in co-operation with the Ministry of Investment and Foreign Trade and the MoE.

The Ministry of Investment and Foreign Trade, established in January 2019, is the successor to the Ministry of Foreign Trade and the State Committee for Investments. It is responsible for implementing the unified state investment policy; co-ordinating efforts to attract foreign investments, primarily direct investments; co-operating with international financial institutions and foreign governmental financial organisations; and devising and co-ordinating unified state policies on foreign trade and international economic co-operation.

The Ministry of Construction, established in April 2018, implements a unified state scientific and technical policy in the field of engineering and technical research for urban planning and construction to increase productivity, reduce construction and installation costs, and introduce innovative energy-efficient and energy-saving projects and solutions into construction.

Main energy legislation

Uzbekistan has been carrying out broad economic reforms since 2016 and since 2019 has embarked on reforming the oil and gas sector and the electricity sector. As part of the reform are presidential decrees, which are detailed in the sectoral chapters of this report.

The main energy sector laws beyond upstream oil and gas include:

- The Law of the Republic of Uzbekistan on the Power Sector No. LRU-225 dated 30 September 2009.
- The Law of the Republic of Uzbekistan on Rational Energy Use No. LRU-412-I dated 25 April 1997.
- The Law of the Republic of Uzbekistan on Using Renewable Energy Sources No. LRU-539 dated 25 May 2019.

New versions of the Electricity Law, the Concept for Reforming the Power Sector and the Roadmap for Reforming the Power Sector are under development, as well as proposals for revising and improving the legislation on public-private partnerships in the gas distribution sector. This work is being carried out with the support of the European Bank for Reconstruction and Development (EBRD), the World Bank and the ADB.

Within the framework of co-operation with the World Bank, the following documents are also being drafted: the Law on Natural Gas, the Grid Code, the Decree on Natural Gas Production, the Decree on Natural Gas Processing, the Law on Modernising the Tax Legislation in order to ensure a contractual approach to developing new fields, proposals aimed at ensuring the protection of socially vulnerable consumer groups (households) via direct subsidies, and improving the services of gas supply to consumers taking into account the gradual increase to market-based energy prices in the domestic market.

Key policies and reform efforts

At the strategic level, Uzbekistan's energy policy goals are laid out in the *Green Economy Transition Strategy for 2019-2030* and the *Electricity Supply Security Concept for 2020-2030*. The EBRD and Japan have also assisted the government of Uzbekistan with

developing the *Roadmap to Carbon Neutral Electricity Sector in Uzbekistan by 2050*, but the document has not been officially adopted.

The strategy's main goal is to achieve long-term sustainable economic development and to meet the country's goal under the Paris Agreement, ratified by Uzbekistan in 2018. The main goal of the concept is to meet the growing electricity demand (the deficit of which was estimated at the level of 9.4% in 2012-2019, and the annual demand growth until 2030 is expected at the level of 6-7%) and to ensure the balanced development of the power sector.

The main purpose of the roadmap is to assist the government of Uzbekistan in reaching the Paris Agreement goals. This document illustrates Uzbekistan's technical and economic opportunity to achieve a zero-carbon energy sector by 2050. According to the results of this modelling, the transition of the power sector to net zero GHG emissions requires USD 94 billion by 2050. This is the lowest level of required investments compared with other development scenarios (ECS, 2022).

Green Economy Transition Strategy for 2019-2030

The strategy's main goal is to achieve long-term sustainable economic development and fulfil Uzbekistan's pledge under the Paris Agreement, ratified by Uzbekistan in 2018. Overall, the strategy sets out nine main goals for 2030, which are summarised as follows:

1. reducing specific GHG emissions per GDP unit by 10% compared with 2010 levels

2. doubling the energy efficiency indicator and reducing the GDP CO_2 intensity

3. bringing the renewable energy sources (RES) share to above 25% of total power generation

4. 100% access to modern, affordable and stable energy supply for all consumers

5. increasing the energy efficiency of industrial enterprises by at least 20%

6. widening the production and use of motor fuel and motor vehicles with improved energy efficiency and environmental performance and developing electric transport

7. improving the efficiency of water use in all economic sectors, deploying drip irrigation technologies on up to 1 million hectares of land, and enhancing the agricultural yield by 20-40%

8. achieving a neutral balance of land degradation

9. increasing the average agricultural productivity by 20-25%.

As for the first goal above, in October 2021, Uzbekistan updated its first Nationally Determined Contribution (NDC) and increased its commitment to reduce specific GHG emissions per unit of GDP from 10% to 35% by 2030 compared with 2010 (see Chapter 8. Energy and Climate). Following the increased ambition of Uzbekistan, the strategy is currently under revision and is to be extended until 2050.

The main authority for promoting, implementing and co-ordinating the measures for reaching the strategy's goals is the Ministry of Economic Development and Poverty Reduction. The goals are to be achieved through developing and implementing activities

identified in national and sectoral action plans and establishing an Interdepartmental Council for Promoting and Implementing a Green Economy.

Tariffs and subsidies

The domestic energy sector's financial viability is a major issue. Investments are needed to modernise and expand electricity, heat and gas infrastructure, but incentives have been weakened by a lack of competition and low end-user tariffs.

As a result of the country's social policy, end-user prices for electricity, natural gas and oil are very low. The tariff system includes cross-subsidies between consumer groups and energy carriers as well as direct subsidies from the state budget. Natural gas pricing particularly creates distortions. For example, it discourages the use of renewable energy for electricity production, heat pump adoption, and the installation of system solutions including the combined generation of DH, cooling and electricity – all of which offer potential efficiency gains and CO_2 emissions reductions.

Low end-user prices imply considerable subsidies (Table 2.1). The IEA user price-gap methodology can be employed to estimate subsidies for fossil fuels consumed directly by end users or as inputs for electricity generation. In Uzbekistan's case, natural gas and oil subsidies make up the difference between export and import prices and end-user prices, i.e. the opportunity cost of pricing domestic energy below international market levels. For electricity, the subsidy is the difference between the reference price and the end-user price.

From 2010, total implied subsidies for oil, gas and fossil fuelled electricity declined by three-quarters to 2016 and then roughly doubled to 2019 before declining again in 2020. This in general reflects the changes in TFC, international oil and gas prices and domestic end-user tariffs. In 2020, Uzbekistan's implied subsidies amounted to USD 3.8 billion, or 6.6% of the country's GDP. The average subsidisation rate was 44%, for a total of USD 112 per inhabitant. Uzbekistan's energy subsidies as a share of GDP have been among the highest in the world.

Table 2.1 Energy subsidies in Uzbekistan, 2010-2020 (real 2019 USD, million)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oil	9	440	474	502	399	134	155	442	980	748	455
Electricity	1 757	1 764	1 581	1 266	885	608	344	1 363	2 488	1 471	1 188
Gas	7 797	6 504	5 232	4 851	3 913	2 514	1 977	3 810	5 562	3 024	2 161
Total	9 563	8 708	7 287	6 619	5 197	3 256	2 476	5 614	9 030	5 244	3 805

Source: IEA (2021), Fossil Fuel Subsidies Database, https://www.iea.org/topics/energy-subsidies.

Moreover, network tariffs for gas and electricity are based on a "cost-plus" methodology that does not encourage utilities to make their services more cost-efficient. On the contrary, this calculation method provides a perverse incentive for utilities to raise their operational costs to justify additional regulated revenue.

In May 2022, the Ministries of Finance, Economic Development and Poverty Reduction, and Energy jointly made the case for further reforms in the electricity and gas sectors, citing interruptions in electricity supply (in 2021, 2 terawatt-hours [TWh] to 3 TWh of electricity was not supplied compared with actual demand), low quality of service and unstable financial situation of enterprises in the industry (Uzbekistan, MEDPR, 2022).

A gradual market reform, including a tariff reform, is required to encourage constructing new generating capacity to meet increasing electricity demand. Proceeding from this, the Ministries of Finance, Economic Development and Poverty Reduction, and Energy have developed a draft resolution of the Cabinet of Ministers "On changing prices for fuel and energy resources", suggesting to raise tariffs closer to market price levels from July 2022 on (see Chapters 3 and 5 for details).

The financial burden of state-owned enterprises (SOEs) in the energy sector is increased

by significant labour surpluses. Removing these structural constraints would require targeted and fiscally more efficient, explicit subsidy mechanisms (ADB, 2020).

Role separation could benefit both the government and SOEs. The World Bank proposes clear distinctions among the state's roles as owner, policy maker and regulator. The aim should be for the state to separate decision-making from ownership responsibilities and act as an engaged and professional owner of its assets, while granting the SOEs operational independence.

In addition, better corporate governance could significantly raise SOE competitiveness and profitability. *OECD Guidelines on Corporate Governance of State-Owned Enterprises* from the Organisation for Economic Co-operation and Development offers helpful international benchmarks (OECD, 2015).

Energy statistics

Detailed, complete, timely and reliable statistics are essential in supporting energy and climate policy making. The 2015 IEA review noted that most data "are not available publicly and are only available for government authorities" (IEA, 2015). Since then, Uzbekistan has made significant improvements in official energy statistics dissemination and more generally in developing open data across government entities: data are released on a public domain and in several user-friendly formats, which is to be commended. Monthly statistics are also available. The general strategy for statistics also defines priorities for energy statistics for the years 2020-2025.

The collection, validation and dissemination of official energy statistics are the responsibility of UzStat. The following statistics are produced:

- annual statistics of energy production, transformation and consumption (statistics on external trade of energy commodities is not publicly available)
- monthly production of energy commodities
- annual energy balance.

The pilot energy balance was released in 2018, and further adoption of the international energy statistics methodology and standards is ongoing. Both national and international stakeholders already use this new information and look forward to the UzStat further improving the quality and disaggregation of energy information. Data for biomass consumption are not available.

The MoE is responsible for compiling operational (monthly) supply data on coal, gas, oil and electricity for government use. These are collected independently from UzStat and are not publicly available.

UzStat collaborates with the main (government) data users to build knowledge on the available data. It is also included in the legislative working groups. The main national users of energy data include the MoE and Uzhydromet, which is responsible for the GHG inventory. UzStat also co-operates and shares energy data upon request with international organisations (IEA, United Nations Statistics Division [UNSD], Joint Organisations Data Initiative [JODI]).

Assessment

Since 20165, the government of Uzbekistan has taken important steps to develop its legal and regulatory climate, diversify its energy mix, and strengthen its energy security. As part of its broad economic reform agenda, the government has initiated major reforms also in the energy sector.

The country is implementing the Green Economy Transition Strategy and an electricity market reform to 2030. The oil and gas sector is also being reformed to bring in competition and efficiency and to launch ambitious petrochemicals sector development. Uzbekistan's significant solar and wind power resources are being developed, as international investors have responded positively to the tenders for capacity and signed PPAs for power generation.

Uzbekistan has major potential to increase the efficiency and diversity of its domestic energy supply and use. Key to realising this potential is a gradual transition to competitive markets with significant private-sector participation and energy prices that reflect the full cost of supply.

Uzbekistan is encouraged to continue energy sector reforms to increase efficiency, attract new entrants and investments, and diversify the energy supply. The level of energy prices is central to attract investment and encourage citizens to use energy efficiently. Tariff reform should therefore be central to these reform efforts. For example, in the gas sector, the gas saved through improved efficiency or through substitution by renewable energy can be used to increase Uzbekistan's production of higher-value-added petrochemicals. To reduce subsidies in the longer term, more emphasis should be placed on explaining to the public that blanket energy subsidies are a highly regressive measure that benefits mainly the well-off. These subsidies should be phased out gradually and replaced by support mechanisms that protect vulnerable groups.

Uzbekistan's energy sector is dominated by SOEs. An important area of reform is the improvement of the corporate governance of these companies. At the same time, the sector needs to be brought to financial viability, for example through debt restructuring and with measures to avoid debts from reaccumulating.

At present, the focus is primarily on what needs to be achieved by 2030. Important as this is, there is a potential case for also creating an integrated and long-term strategy that would build on the various strategy documents and plans currently under consideration, provide longer-term plans through to 2040 or 2050, and bring together all the various strands of work on energy and climate change. Any such plan would be all the stronger for

consultation with private-sector and other external stakeholders; for putting in place carefully thought through governance arrangements underpinned by close cross-government co-ordination; and for including clear targets and an indication of how they are to be delivered.

A clear vision for achieving decarbonisation and energy security affordably is needed to steer energy sector policy in the upcoming decade and beyond. This should be reflected in an overarching integrated energy and climate vision, along with a concomitant strategy and action plan, and these should be carefully aligned with the country's economic policies.

In particular, the IEA strongly emphasises to the government that greater energy efficiency can benefit the economy, reduce pollution and create additional jobs, and encourages it to rapidly adopt the laws, strategies, policies and measures needed to realise this potential. Strong policies on energy efficiency will become increasingly relevant because more buildings will be constructed, more appliances and equipment sold, and more vehicles purchased in the years and decades ahead. A long-term approach is therefore needed to keep Uzbekistan on an environmentally sustainable and economically efficient energy pathway.

The current and foreseen changes in Uzbekistan's energy sector and the overall significant growth of energy demand and urbanisation will inevitably generate a demand for new skills and capabilities in a variety of fields, including, for example, renewables engineering, energy efficiency technologies, emissions measurement expertise, and energy and climate modelling capabilities. Plans to develop these skills, developed in consultation with schools, universities and research organisations, as well as the private sector, and backed by the necessary financial resources, should help to minimise the risk of future capability gaps slowing progress, while also helping create new skilled jobs in the future economy.

Energy research, development and innovation is necessary to help Uzbekistan maintain and improve its economic competitiveness, and to enable diversification away from natural gas. For these reasons, the IEA encourages the government to step up its energy innovation efforts significantly.

Energy data management and use

The IEA agrees with the energy statistics priorities defined in the UzStat statistics strategy and encourages their implementation. It will be useful to regularly update the strategy to reflect emerging needs.

A lot of energy information is already available online. This could be complemented with the release of additional statistics on energy trade and commodity balances (including monthly data) in user-friendly formats on the relevant (UzStat, MoE) websites. In addition, more electronic data could be shared between government agencies.

The number of UzStat staff working on energy statistics is very low, only two. This virtually prohibits further development of the energy balance and any new data production, including household energy consumption surveys or energy efficiency indicators. Sufficient funding from the state budget would ensure sustainability for the activities, and higher salaries would help maintain the developed human capacity.

The pilot energy balance could be strengthened by further alignment with the International Recommendations for Energy Statistics (UNSD, 2018) and more detailed data on energy

consumption. This would require improving the underlying data collection surveys e.g. for industry, and collecting additional data for households. This would allow quantifying the contribution of biomass in the energy mix.

Energy efficiency is one of the main strategic areas for the government. To monitor the impact of any new energy efficiency policy, relevant indicators should be developed by a dedicated entity with sufficient analytical capacity. Most importantly, stakeholder co-operation (UzStat, MoE, Ministry of Transport) is essential, given that energy efficiency cuts across all sectors of the economy.

In parallel to adopting energy efficiency legislation, it will be important to clarify responsibilities for regular energy efficiency monitoring among the relevant stakeholders to maximise synergies (data collection, surveying, analysing results, modelling/estimating data, calculating indicators). This activity should review all energy consumption in the economy (residential, transport, industry, services), and result in a clear framework for holistic treating of energy efficiency information in Uzbekistan.

Conducting a specific household energy consumption survey (e.g. every five years) to obtain disaggregated information on the types of energy and technologies they use would allow the development of specific energy efficiency indicators for the sector. It is important to take into account the lessons learned from the pilot survey conducted in 2020. In addition, planning, implementing and analysing the survey results should benefit from the best international practice.

Recommendations

The government of Uzbekistan should:

- Build on existing policy work and plans with a view to developing an integrated long-term strategy for energy and climate change, and the related capacity, ensuring effective co-ordination among all relevant government ministries and agencies as well as consultation with the private sector, higher education bodies and other stakeholders.
- Continue gradual energy reforms to develop competitive markets, based on market prices that reflect the full cost of energy supply, and continue its work to create an independent and well-resourced energy regulator; provide support only for the most vulnerable customers.
- Build the necessary professional capabilities and skills needed in the future energy sector, including through education and training, and improve public awareness of the reasons for energy policy changes and their benefits.
- Diversify the energy mix, moving gradually away from heavy energy and economic dependence on natural gas and other fossil fuels.
- Align the corporate governance of state-owned energy enterprises with the OECD guidelines.

- Address financial imbalances in the electricity, oil, natural gas, coal and DH sectors, including by:
  - Resolving the debt issue in state- and municipality-owned energy companies.
  - Intensifying efforts to avoid the re-emergence of debt.
- Enable local scientific universities and institutions involved in the energy sector to take an active role in research and policy design and energy projects, including solar, hydro and wind, and further build capacity to develop local technology and industry applications.
- Further develop national energy statistics to inform policy decisions by:
  - Maintaining its close co-operation with UzStat and continuing to use official energy statistics as the foundation for analysis in strategic documents and when drafting new legislation.
  - Providing sufficient resources (human and financial) for UzStat to expand the collection and reporting of energy data and supporting co-operation at both the national and international levels to develop staff capacity.
  - Encouraging UzStat to further align the collection and dissemination of the official energy statistics with the international recommendations, particularly by increasing data disaggregation and accuracy of energy end uses.
  - Engaging with UzStat and other data providers and users to ensure all necessary energy information is available, accessible and accurate to all stakeholders, including academic institutions and the entity responsible for the GHG inventory.
  - Envisioning a clear division of work covering energy efficiency monitoring on all sectors of economy among the relevant institutions, i.e. UzStat, MoE, etc.
  - Conducting household energy consumption surveys at regular intervals (e.g. every five years) to monitor energy efficiency policy implications in the residential sector and to increase the level of data disaggregation particularly on biomass utilisation.
  - Encouraging UzStat to update the statistics strategy periodically to ensure continuous improvement of energy statistics.

References

ADB (Asian Development Bank) (2020), *Reforms, Opportunities, and Challenges for State-Owned Enterprises*, https://www.adb.org/publications/reforms-opportunities-challenges-state-owned-enterprises.

ECS (Energy Charter Secretariat) (2022), *In-Depth Review of the Energy Efficiency Policy of the Republic of Uzbekistan*, https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Uzbekistan_2022__en.pdf.

IEA (International Energy Agency) (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics (accessed 10 June 2022).

IEA (2015), *Energy Policies Beyond IEA Countries: Caspian and Black Sea Regions 2015*, Energy Policies Beyond IEA Countries, IEA, Paris, https://doi.org/10.1787/9789264228719-en.

OECD (Organisation for Economic Co-operation and Development) (2015), OECD Guidelines on Corporate Governance of State-Owned Enterprises, https://www.oecd.org/corporate/guidelines-corporate-governance-soes.htm.

UNSD (United Nations Statistics Division) (2018), *International Recommendations for Energy Statistics*, https://unstats.un.org/unsd/energystats/methodology/ires.

Uzbekistan, MEDPR (Ministry of Economic Development and Poverty Reduction) (2022), Explanatory note to the draft Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On the use of prices for fuel and energy resources", https://mineconomy.uz/ru/news/view/4616.

Uzbekistan, UzStat (The State Committee of the Republic of Uzbekistan on Statistics) (2022), National accounts, https://www.stat.uz/en/official-statistics/national-accounts.

Uzbekneftegaz (2021), Prospectus, 12 November 2021, https://webdev.ung.uz/media/allfiles/files/f04f93d871004f4f8576f7750371d09e.PDF.

Uzhydromet (2021), *First Biennial Update Report of the Republic of Uzbekistan under the UN Framework Convention on Climate Change,* https://unfccc.int/sites/default/files/resource/FBURUZeng.pdf..

World Bank (2022), Uzbekistan, https://thedocs.worldbank.org/en/doc/d5f32ef28464d01f195827b7e020a3e8-0500022021/related/mpo-uzb.pdf, https://stat.uz/en/official-statistics/prices-and-indexes.

3. Oil and natural gas

Key data

(2020 provisional)

Oil production: 2.8 Mt (0.8 Mt crude oil, 2.0 Mt gas condensates/NGLs), -31.1% since 2010

Oil imports: 0.5 Mt, -38.7% since 2011

Net oil product imports: 0.71 Mt (0.75 Mt imports, 0.04 Mt exports)

Share of oil: 6.5% of domestic energy production, 9.5% of TES, 0.7% of electricity generation, 11.9% of TFC

Oil consumption by sector: 4.2 Mt (transport 70.8%, residential 10.5%, industry 7.4%, electricity and heat generation 4.2%, others 7.1%)

Gas production*: 49.8 bcm, -24.5% since 2010

Gas exports: 3.1 bcm, -5.9% between 2010 and 2019, -75.0% between 2019 and 2020

Share of natural gas: 89.3% of domestic energy production, 82.7% of TES, 87.8% of electricity generation, 62.6% of TFC

Gas consumption by sector: 46.1 bcm (electricity and heat generation 37.2%, residential 26.3%, industry 11.8%, transport 8.1%, other energy 6.5%, services/other 10.1%)

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

Overview

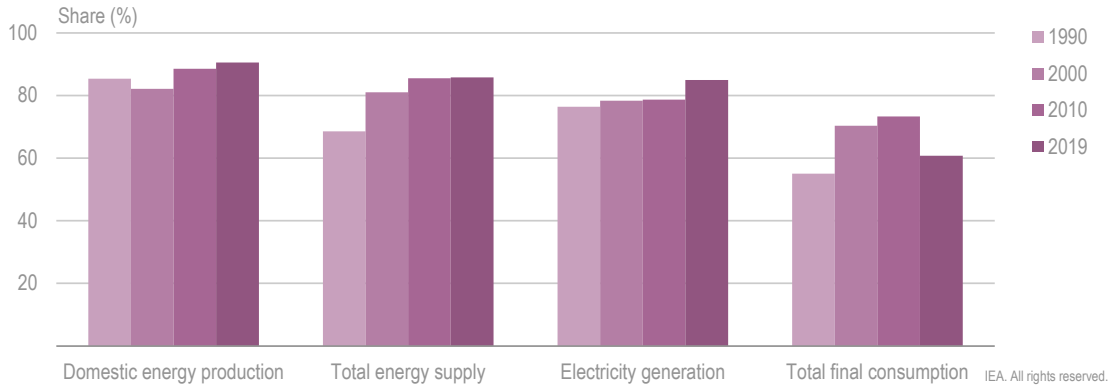
Natural gas dominates Uzbekistan's energy supply. It makes up 85-86% of both TES and electricity supply and is the main energy source in all sectors, including transport. It has also been a major source of export revenue, but the government now plans to stop exports by 2025 and use the gas for petrochemicals production and domestic energy supply. At the current rate, however, the country's gas reserves will be depleted in less than 20 years, while the government foresees natural gas demand rising by 30% to 65 bcm by 2030.

Uzbekistan has adopted legislative incentives to attract foreign investment to maintain production as well as to develop new oil and gas fields to meet a growing domestic demand. To encourage the necessary investments, it intends to gradually raise the very low gas tariffs to cost-recovering levels. Oil prices were deregulated in 2020, and a full gas price deregulation is planned for 2026. A gas tariff reform would encourage both more efficient gas use and the use of the country's significant solar and wind power potential for electricity generation. It would also increase the financial viability of the sector, which needs investment in modernising gas pipelines, for example. Efforts to modernise and increase oil refining and petrochemicals production are proving successful. The state-owned Uzbekneftegaz was unbundled in 2019, and the government has launched a programme to partly privatise its holdings in the sector in the coming years.

The oil and gas sector has traditionally been the largest industry destination of foreign direct investment (FDI) in Uzbekistan, accounting for up to 40% of all FDI over the past ten years, according to the Investment Promotion Agency of Uzbekistan, Ministry of Investment and Foreign Trade of Uzbekistan. In 2020, Uzbekneftegaz provided 5.4% of total revenues to the state budget and 3.5% of GDP (Uzbekneftegaz, 2021). At the same time, the revenues forgone because of gas and oil price subsidies equalled USD 2.6 billion, or 4.5% of GDP, according to IEA estimates.

Uzbekistan holds emergency stocks of gas and oil products, but the details of the stock mechanism are confidential.

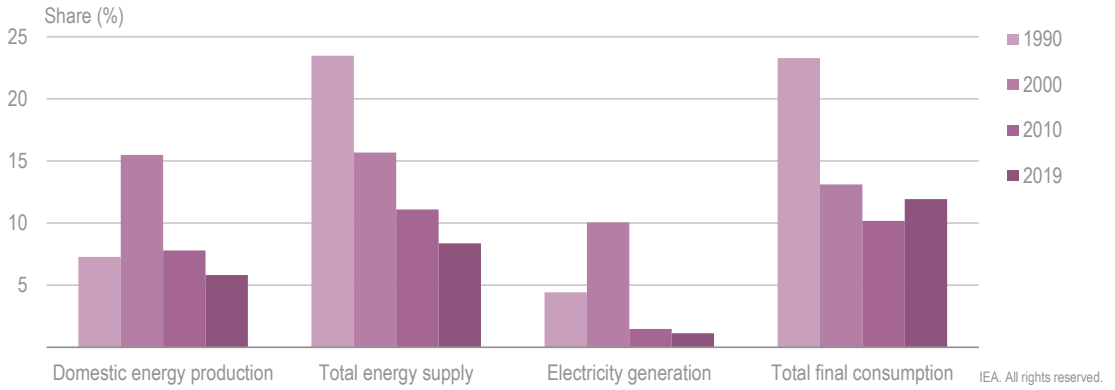
Figure 3.1 Share of natural gas in Uzbekistan's energy system, 1990-2019



Natural gas is the main fuel in all sectors of the economy.

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

Figure 3.2 Share of oil in Uzbekistan's energy sector, 2000-2020



The importance of oil in Uzbekistan's energy system has declined since 2000.

* Includes both field and plant condensates (natural gas liquids [NGLs]).
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Reserves and resources

According to BP, at the end of 2020, Uzbekistan had 800 bcm of natural gas reserves and 600 million barrels (around 100 million tonnes [Mt]) of oil reserves. At the current rate of production, the gas reserves would last for 18 years and the oil reserves for 35 years (BP, 2021).

The eight main production fields are Shurtan, Zavardy, Kokdumalak, Alan, Adamtash, Boysun, Kandym and Gissar. The reserves are mainly located in the Kashkadarya, Bukhara and Fergana regions. Overall, there are around 280 oil, gas and NGL deposits.

The state-owned Uzbekneftegaz holds around half of the country's hydrocarbons reserves, including three-quarters of the gas reserves and one-quarter of the oil reserves (Uzbekneftegaz, 2021). Most of the oil reserves have been owned by the privately held Sanoat Energetika Guruhi company since 2021 (see below).

Supply

Production regulation

Several government entities oversee the oil and gas industry, including the Special Commission of the Cabinet of Ministers, the Ministry of Economic Development and Poverty Reduction, and the Ministry of Finance. It is also regulated by the Uzbekistan State Inspection on Monitoring the Use of Oil Products and Gas.

The government does not carry out licensing rounds, but awards licences on a project-by-project basis to multiple companies under production sharing agreements (PSAs). The state-owned Uzbekneftegaz is involved in virtually all oil and gas exploration and production projects. Most such projects are structured as joint ventures (JVs) with foreign oil and gas companies, such as Lukoil, Gazprom and China National Petroleum Corporation (CNPC) (Uzbekneftegaz, 2021).

The main legislation governing the oil and gas industry in Uzbekistan includes the Foreign Investments Law, the Subsoil Law, the Investment Activity Law, the Production Sharing Agreements Law and the Law on Guarantees and Measures on Protection of Foreign Investors. To encourage more oil and gas production, the Presidential Decree PP-6319 "On measures for further stimulation of geological exploration and improvement of taxation for subsoil users" was adopted in October 2021. The Subsoil Decree introduces several types of incentives, including reduced subsoil use taxes, and exemptions from corporate property tax and customs duties for equipment.

The government introduced in 2020 a risk service agreement (RSA) to encourage production increases in hard-to-recover and mature fields. Under the RSA, operators carry out works to increase hydrocarbons production at their own expense and risk with the right to a fixed share of the incremental output in return. In Uzbekistan, the operator may sell its share of crude oil and gas condensate as a raw material in Uzbekistan or process and sell it either in Uzbek markets or abroad, whereas it can sell its share of natural gas only in Uzbekistan (Kosta Legal, 2020).

Exploration

Uzbekistan is also planning to sign more upstream exploration deals with foreign companies. To facilitate this, the government has redesigned the exploration process, introducing smaller blocks that are more flexible. The most promising regions for new licensing agreements are the Ustyurt and the Bukhara-Khiva regions. Uzbekneftegaz and Lukoil created an exploration JV in 2020.

Most of Uzbekneftegaz's output comes from small fields in the Bukhara-Khiva region in south-west Uzbekistan that are in decline. The company is implementing a USD 3 billion Hydrocarbon Programme, which aims to attract foreign investment and modern technologies to maintain and increase hydrocarbon production by accelerating the construction and development of wells and facilities on prospective areas and fields. The company expects the programme to create 3 000 jobs. It will fund one-third of the programme out of its own funds and two-thirds through foreign loans.

Natural gas supply

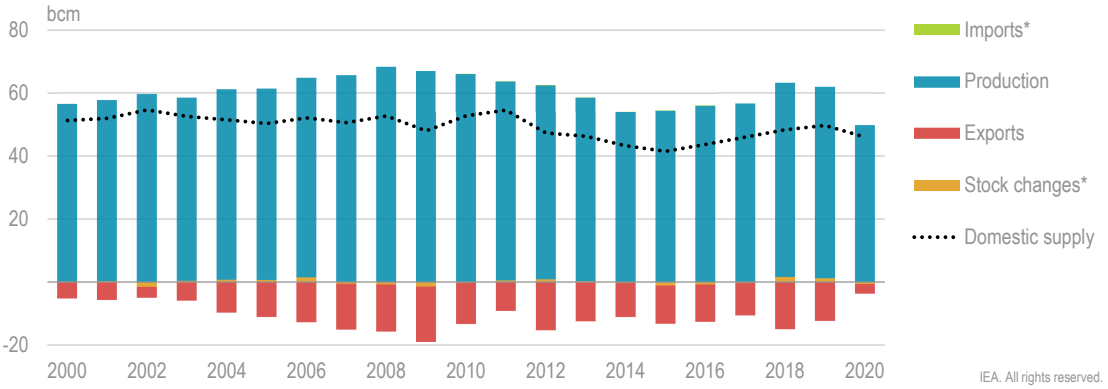
Uzbekistan is a large producer of natural gas (world's 15th largest in 2020), with total production of 49.8 bcm in 2020. It is also a gas net exporter, but as domestic demand is growing faster than production, the surplus for exports is dwindling. The government has decided to stop exports by 2025 and direct the gas for higher-value petrochemicals production. It has also planned and is already taking measures to curb domestic gas demand growth, for example by promoting higher energy efficiency across the economy, incentivising new solar, wind and hydropower generation capacity, and raising the very low end-user gas tariffs.

Gas production peaked in 2008 and gradually declined until 2014, again growing until 2018-2019. In 2020, production dropped more than ever, by almost 11 bcm, or 18%. This was mostly related to Covid-19, which reduced gas demand in both Uzbekistan and its export countries. Before 2020, gas production in Uzbekistan was around 60 bcm per year. According to preliminary data, gas production grew by 8% to 54 bcm in 2021.

Uzbekneftegaz, the national oil and gas company, is the largest gas producer. In 2020, it produced 33.1 bcm, or 66.5% of the total. The company expects to increase production to 34.5 bcm by 2026 (Uzbekneftegaz, 2021). The collapse in trade in 2020 particularly affected the export-oriented Lukoil, which had to halt its gas production for several months (S&P Global, 2020).

Lukoil's strategy has been to invest heavily in its two PSAs – Kandym and South Gissar – and focus on exporting the gas to China for a higher price than available in Uzbekistan. This has contrasted with Gazprom, which holds minority interests in several small fields in western Uzbekistan, close to the export pipelines to the Russian Federation (hereafter, "Russia") (OIES, 2019).

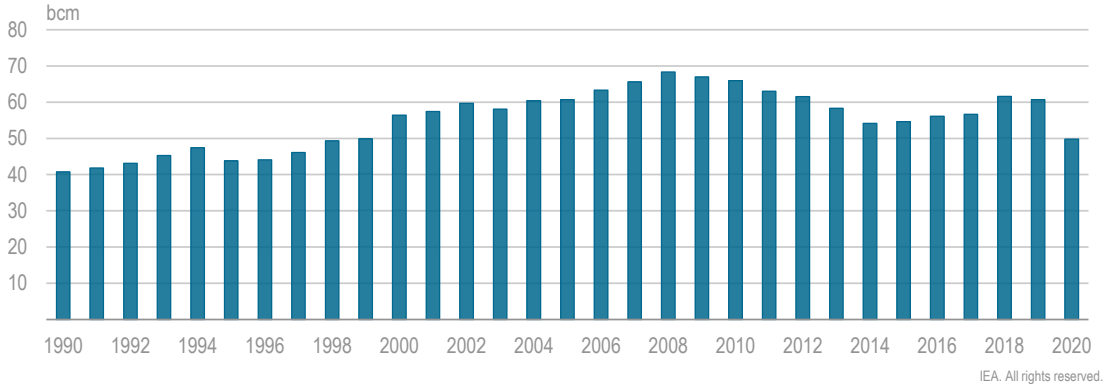
Figure 3.3 Natural gas supply in Uzbekistan, 2000-2020



Domestic consumption of natural gas decreased by 10% between 2000 and 2020.

* Not visible at this scale.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 3.4 Natural gas production in Uzbekistan, 1990-2020



Gas production peaked in 2008 and has since decreased by 27%.

Note: Represents marketable quantities, i.e. excluding quantities reinjected, vented or flared.
Source: UzStat (2022a), Production and consumption of natural gas, https://api.stat.uz/api/v1.0/data/tabiiy-gazni-qazib-chiqarish-va-istemoli?lang=en&format=pdf.

Trade

Uzbekistan has historically exported more than 10 bcm (2010-2019 average 21% of production) of its gas, mainly to Russia, southern Kazakhstan and since 2014, to China. However, declining production and rising domestic demand has reduced those volumes notably: in 2020 only 6% of production was available for exports.

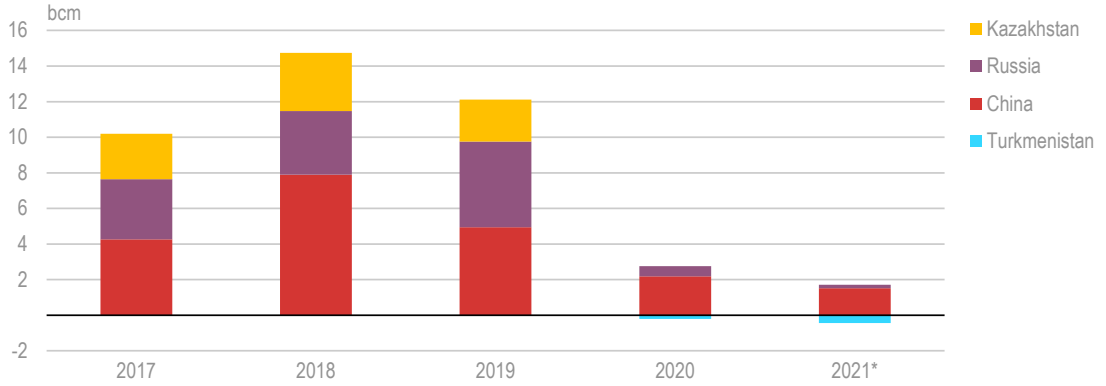
The government has decided to phase out gas exports entirely by 2025. Russia has plenty of its own gas, and China uses its multiple supply sources to put pressure on price. With these choices, Uzbekistan has decided to use the gas domestically to increase energy security and build a petrochemicals sector where it can use the gas to add value to it.

According to official data, Uzbekistan exported 3.1 bcm in 2020, compared with 12.2 bcm in 2019. An exact breakdown is not available, but the estimates based on customs data from UN Comtrade indicate that China was the main export destination until 2020. The Covid pandemic disrupted gas exports in 2020. Exports to China fell to 3 bcm, around 70% lower than 2019, and shipments to Russia and Kazakhstan were suspended entirely. Gas export value collapsed from USD 2.2 billion to USD 478 million (S&P Global, 2020).

Uzbekistan was also forced to cut gas exports in December 2020 by at least 7 million cubic metres (mcm) per day to 8 mcm/day after local supply shortages were reported during winter, and the country actually had to import small volumes of gas, for USD 50 million, according to the State Statistics Committee on foreign trade turnover. Exports were also halted in winter 2021/22. There is no public information on how the export volumes are split between Uzbekneftegaz and Lukoil.

The government expects gas exports to reach 3.3 bcm in 2022, and, to meet rising domestic demand, gas imports to increase from 0.2 bcm in 2019 to 4 bcm in 2022 (Uzbekistan, MEDPR, 2022a). In 2019 and 2020, the imports came from Turkmenistan, according to UN data. The rising imports will weaken the gas sector's finances (see below).

Figure 3.5 Uzbekistan's natural gas trade by country, 2017-2020



Uzbekistan plans to phase out natural gas exports by 2025 and use the gas domestically, instead.

* Estimates based on 2020 and UN Comtrade data.
Sources: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.; United Nations (2022) Comtrade database, https://comtrade.un.org/data/.

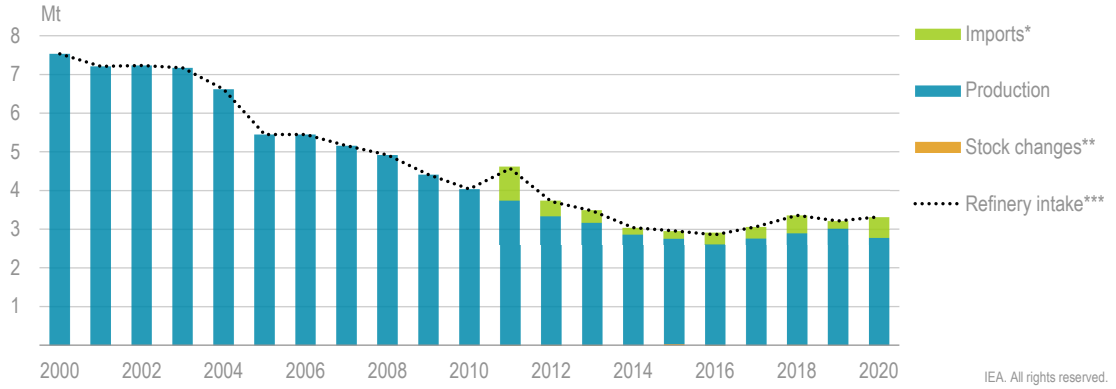
Oil supply

Crude oil

Uzbekistan produced 2.8 Mt of oil and gas condensates in 2020, an average of about 60 000 barrels per day, down over 30% from 2010. Domestic production peaked in 1999 at over 8 Mt. Uzbekneftegaz produced 58% of all oil and gas condensate in the country in 2020.

Uzbekistan has two operating refineries in Bukhara and Fergana processing the domestic and imported crude oil as well as stabilised condensates from the Mubarek gas processing plant. Detailed data on oil flows between production, processing and refining are not available, but estimates based on available data place the share of imported crude in the refinery feedstock to around 10%. Crude oil is mainly imported by rail from Turkmenistan, Kazakhstan and Russia.

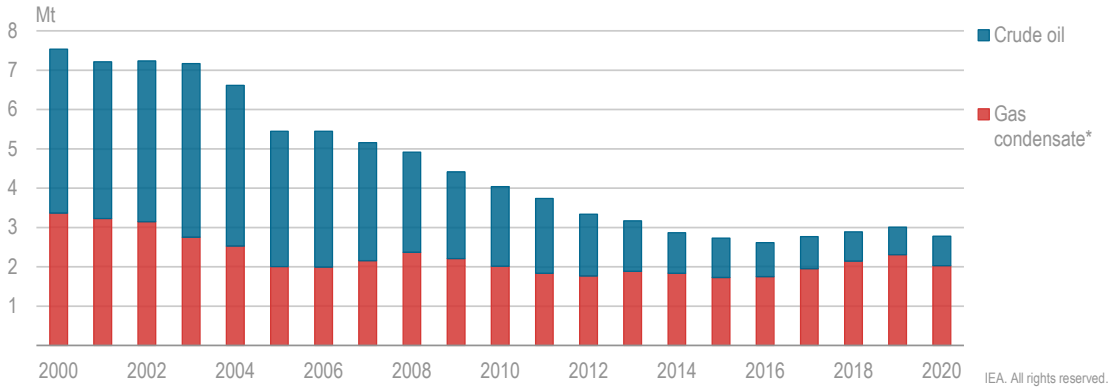
Figure 3.6 Crude oil and condensate supply in Uzbekistan, 2000-2020



Around 90% of the crude oil and condensates for Uzbekistan's refineries are produced domestically.

* Official import statistics available since 2011, ** Not visible at this scale, *** Includes oil refineries and gas processing plants for the separation of liquefied petroleum gases (LPG) from condensates.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

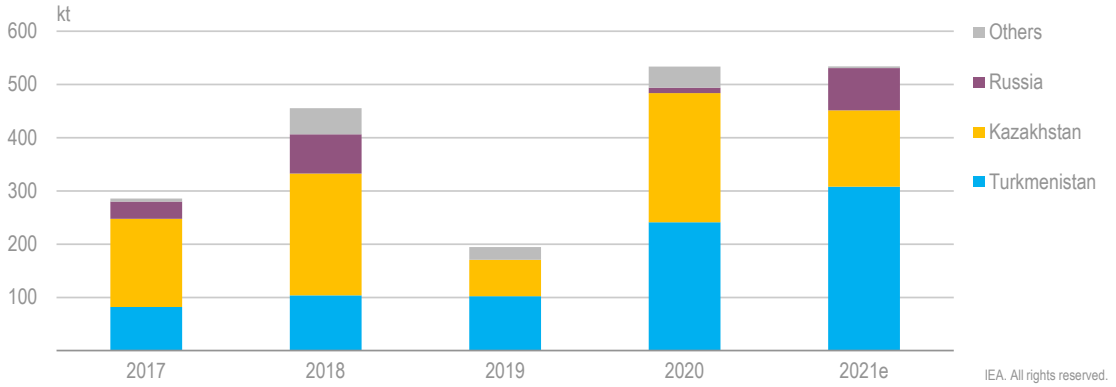
Figure 3.7 Crude oil production in Uzbekistan, 2000-2020



Underinvestment has led to declining production from Uzbekistan's oil fields.

* Includes both field and plant condensates (NGLs).
Source: UzStat (2022b). Oil and gas condensate production, https://api.stat.uz/api/v1.0/data/neft-va-gaz-kondensati-qazib-chiqarish?lang=en&format=pdf.

Figure 3.8 Crude oil imports to Uzbekistan by country, 2017-2021



Uzbekistan imports crude oil directly from neighbouring countries.

Note: kt = kilotonne.
Source: United Nations (2022) Comtrade database, https://comtrade.un.org/data/.

Oil products

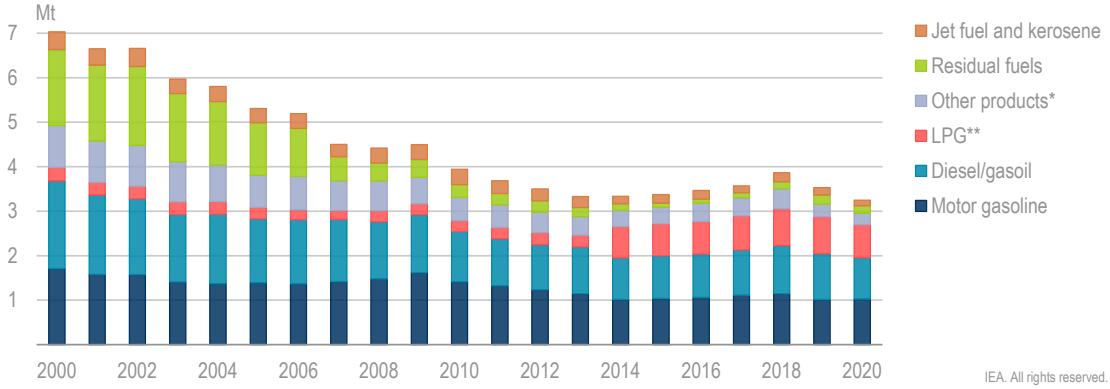
While exhaustive data for the oil processing throughputs are not available, based on recent data from UzStat and historical IEA estimates, one can conclude that the production of crude oil and oil products has fallen at the same rate. Crude oil production has fallen, and its import routes are limited and their capacity constrained. The country's refineries have also become outdated. In 2020, refined products output totalled 3.2 Mt, a decrease of 18% since 2010.

The government policy is to modernise the country's oil refining sector to increase both fuel quantity and quality, and work is ongoing at the two largest refineries, Bukhara and Fergana. A challenge for increasing oil products production is sourcing the crude oil. Pipeline connections do not exist, and the refineries receive oil mainly by rail. One solution is to increase domestic production, and to this end, the government introduced in 2020 the RSA to attract more explorers and producers to the sector (see above).

According to the available data, oil product imports exceeded exports in 2018, making Uzbekistan a clear net importer of oil products (Figure 3.10). Until then, refinery output had largely satisfied Uzbekistan's domestic demand and also allowed for modest exports. Preliminary data for 2020 suggest that imports covered 30% of Uzbekistan's demand for diesel, 19% for motor gasoline and 35% for fuel oil (UzStat, 2022c).

Domestic production is set to exceed oil products imports again in the next few years, if the plans to develop new oil wells, apply modern extraction methods, and expand and modernise oil refining capacity are implemented. Increased domestic refinery production may, however, lead to a need for higher crude oil imports.

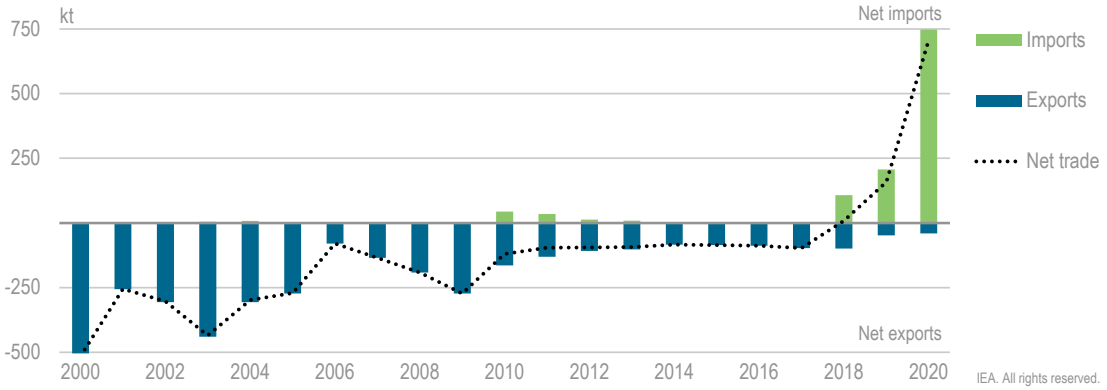
Figure 3.9 Production of oil products in Uzbekistan, 2000-2020



Uzbekistan's refineries produce mostly fuels for road transport.

* Includes refinery gas, aviation gasoline, white spirits, lubricants, bitumen, paraffin waxes, petroleum coke and unspecified oil products.
** Includes butane and propane output from the gas processing plant.
Note: The refinery output is partially based on IEA secretariat estimates, particularly prior to 2018.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 3.10 Uzbekistan's oil products trade, 2000-2020



Uzbekistan has become a net importer of oil products, as domestic production has lagged behind the rising demand.

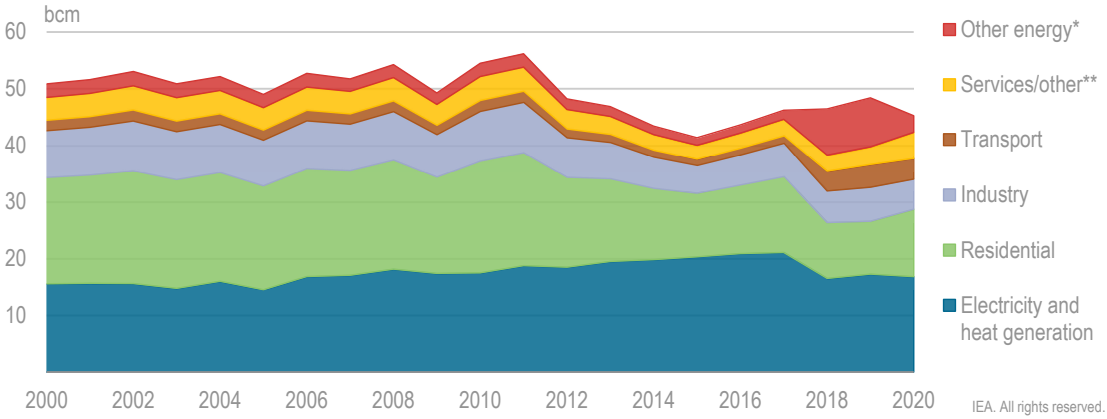
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Demand

Natural gas

Natural gas is the main energy source in all sectors of Uzbekistan's economy, including transport. Following a decrease until 2015, demand recovered almost by 20% until 2019, but then declined 7% year-on-year to 46.1 bcm in 2020. Gas supply had rapidly tightened in recent years due to declining production and growing consumption.

Figure 3.11 Natural gas demand in Uzbekistan by sector, 2000-2020



Gas demand was increasing fast until 2020, when Covid restrictions led to a 7% decline in demand.

* Includes oil and gas extraction, own use in power sector, unspecified energy sector consumption and distribution losses.
** Includes commercial and public services, agriculture, forestry, and unspecified consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Electricity and heat production accounted for 37% of domestic gas demand in 2020, followed by the residential sector (26%), industry (12%), services (10%), transport (8%) and energy sector own use (including distribution losses) (6%).

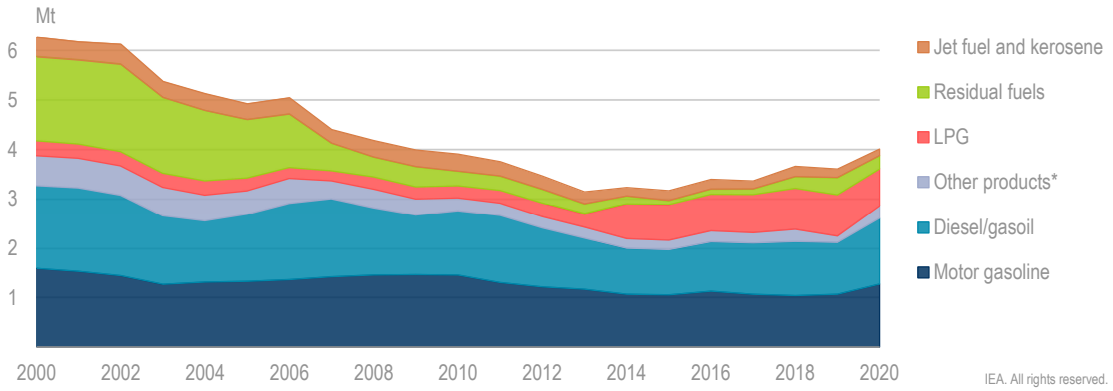
Gas demand for heating varies according to temperature. Around half of the cars in Uzbekistan run on CNG, and in recent winters, growing gas consumption for heating has led to long queues at filling stations, underlining the risks of high gas dependence in the country's growing economy.

The government does not publish official scenarios of forecasts for gas consumption. However, it foresees natural gas demand rising by 30% to 65 bcm by 2030 (Uzbekistan, MEDPR, 2022a).

Oil

Domestic demand for oil was 4.2 Mt in 2020, almost 50% higher than domestic oil production. By product, around 33% of oil demand in 2020 was diesel fuel, mainly consumed in transport and heavy industry. Motor gasoline was almost on par (32%). It is used mainly in the transport sector. LPG covered 19% of oil demand, and used mainly in the residential sector but also by cars. The remainder of the consumption consisted of residual fuels (7%), jet fuel and kerosene (3%), and non-energy oil products such as bitumen and lubricants (6%).

Figure 3.12 Oil consumption in Uzbekistan by product, 2000-2020



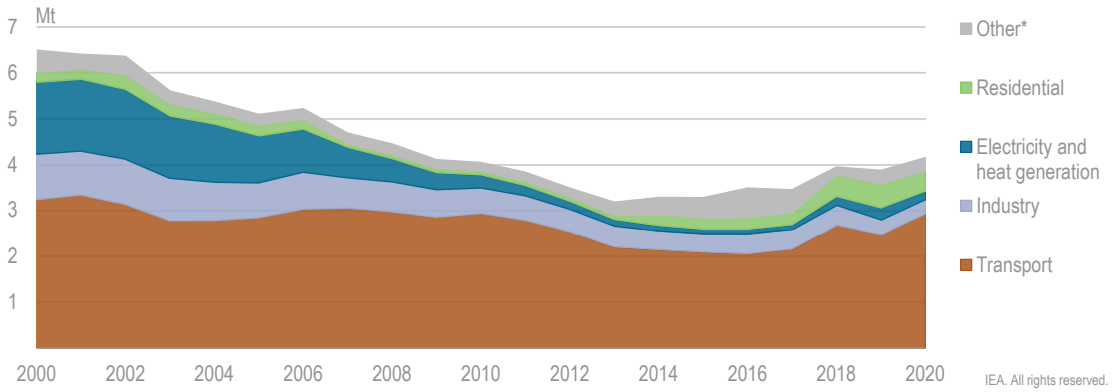
Oil product consumption mostly consists of transport fuels.

* Includes refinery gas, aviation gasoline, white spirits, lubricants, bitumen, paraffin waxes, petroleum coke and unspecified oil products.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

The transport sector consumed 71% of all oil products in 2020 (breakdown: 56 percentage points diesel and motor gasoline, 11 percentage points LPG and 4 percentage points aviation fuel). According to the Ministry of Transport, in early 2019, 50% of passenger cars and trucks used CNG (methane), 36.6% gasoline, 13% LPG and 0.4% diesel (gasoil). The government promotes CNG use for transport and LPG use for household use (UNECE, 2020). In 2020, the residential sector accounted for 11% of the country's oil product demand, almost 90% of which was LPG for cooking.

Industry represented 7% of demand for oil products in 2020, particularly in the iron and steel, chemical, and non-metallic mineral industries. About 44% of the product demand in this sector was for diesel, and 25% was for petroleum coke.

Figure 3.13 Oil consumption in Uzbekistan by sector, 2000-2019



Oil demand more than halved from 2000 to 2020, but has increased fast since then.

* Includes commercial and public services, agriculture, forestry, and unspecified consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Oil and gas sector reform

The oil and gas sector is at the heart of Uzbekistan's broad economic reforms to diversify the economy, develop domestic industries and reduce product imports. A key reform objective is to enable the country to monetise its natural gas resources via production of export-oriented, high-value petrochemicals products.

The Green Economy Transition Strategy for 2019-2030 includes the following objectives for the sector:

- Reduce natural gas losses in the production, processing, transportation and distribution stages by upgrading compressor stations, low- and medium-pressure gas distribution networks, and the gas transportation system with effective technologies for monitoring hydrocarbon resource losses (i.e. a supervisory control and data acquisition [SCADA] system).
- Introduce modern gas distribution and metering technologies.
- Reduce GHG emissions during the processing and storage of oil and gas.
- Reduce GHG emissions from the combustion of associated gases once processes for their utilisation and advanced processing have been introduced.
- Introduce alternative energy sources at oil and gas production facilities.

The oil and gas sector reform was laid out in Presidential Decree No. 4388 ("On the measures on securing a stable supply of energy resources to the economy and the population, financial restructuring and improving the oil and gas sector management system", dated 9 July 2019). The decree contains the following objectives for the reform to 2030:

- Increase hydrocarbon production (specifically, Uzbekneftegaz is to raise gas output to 42.3 bcm and LPG output to 1.5 Mt by 2024).
- Modernise the gas transmission system.

- Improve accounting and control of production, processing, transportation and sale of natural gas.
- Optimise investment projects and improve their implementation.
- Strengthen the financial discipline and improve pricing in the industry.

Before August 2019, the vertically integrated state-owned oil and gas company Uzbekneftegaz was in charge of natural gas production and processing, network operations, and supply to customers. As part of the reform, Uzbekneftegaz was unbundled into joint-stock company (JSC) Uzbekneftegaz (oil and gas exploration and production, oil refining and gas processing, petrochemicals production, retail oil product sales), Uztransgaz JSC (gas transportation and supply to directly connected customers), and Khududgaztaminot JSC (gas and LPG distribution and supply to retail customers). Several smaller state-owned oil and gas companies were incorporated into Uzbekneftegaz JSC.[1]

The new companies remain state-owned, but the government is planning to partially privatise up to 49% of Uzbekneftegaz and Khududgaztaminot in the next years. Since January 2019, the newly established State Assets Management Agency (SAMA) is responsible for restructuring, corporatisation and optimisation of Uzbekneftegaz's shares and assets. SAMA also holds the shares of Uztransgaz and Khududgaztaminot, while the Ministry of Finance holds 99.94% of the shares of Uzbekneftegaz. Uzbekneftegaz and Uztransgaz have also begun to use international accounting and reporting standards, with the help of EY, a consultancy.

In addition to the state-owned Uzbekneftegaz, Uztransgaz and Khududgaztaminot, the main players in the oil and gas industry include Lukoil, Gazprom, Korea National Oil Corporation (KNOC), CNPC and the recently emerged Sanoat Energetika Guruhi.

Gas pipeline infrastructure, operations and storage

Gas transportation – Uztransgaz

Uztransgaz JSC purchases the natural gas it transports from gas production and processing companies, including JVs and foreign companies operating under PSAs. It sells the gas under direct contracts to consumers connected to main gas pipelines, as well as under commission agreements with Khududgaztaminot JSC for consumers connected to gas distribution networks. The company has over 13 500 kilometres (km) of main transmission gas pipelines, 23 compressor stations and 418 gas distribution stations. Uztransgaz is also in charge of gas imports and exports.

The Bukhara-Tashkent-Bishkek-Almaty natural gas pipeline, with a capacity of 3.2 bcm per year, is the main national pipeline. It supplies natural gas also for Kyrgyzstan and southern Kazakhstan. The Mubarek-Shurabad-Dushanbe natural gas pipeline connects Uzbekistan and Tajikistan (see below for gas transit pipelines). In recent years, two natural gas pipelines, Gazli-Kagan and Gazli-Nukus, were built to connect the Ustyurt Plateau and Bukhara-Khiva region with the existing pipeline system.

[1] These companies and entities include JSC Uzburneftgas, JSC Uzneftgasdobicha, JSC Uznefteproduct and JSC Uzneftegasmash as well as the Neftegasexport LLC, O`zneftegasgeologiya LLC, Neftegasdobicha-Inginiring LLC, UE Usturt GMK direktsiyasi, JSC Jarkurganneft, Geoburneftgasservis LLC, Neftegasinvest LLC and the Interdepartmental Training Centre LLC. Also, oil extracting and gas processing companies (Mubarekneftegas LLC, Shurtanneftegas LLC, Usturtgas LLC, Gaslinneftgasdobicha LLC, JSC Andijanneft and Mubarekskiy GPZ LLC).

Official information on Uzbekistan's gas transportation system losses is restricted and is not publicly available.

As of 1 January 2021, Uzbekistan had no officially approved methodology for setting tariffs for natural gas transportation and distribution. In practice, all tariffs in the natural gas sector are based on the cost-plus method and set by the Ministry of Finance jointly with the MoE.

Gas distribution – Khududgaztaminot

The main tasks of JSC Khududgaztaminot are the operation of gas distribution grids and related equipment, purchasing, supply, storage and sales of LPG to the households and social sector. The DSO purchases gas from JSC Uztransgaz and from natural gas producers connected directly to the gas distribution grid at tariffs set by the Interdepartmental Tariff Commission under the Cabinet of Ministers of the Republic of Uzbekistan. JSC Khududgaztaminot owns more than 90 200 km of gas pipelines and 81 400 gas distribution points.

Official information on Uzbekistan's gas distribution system losses is restricted and is not publicly available.

Transit capacity

Uzbekistan's export and transit capacity to Central Asia, Russia, Europe and China is over 120 bcm/year, of which 55 bcm/year is via the Central Asia-China pipeline and 70 bcm per year via the Central Asia-Centre pipeline to Russia. Uzbekistan is an important transit country for Turkmen gas. Gas has been transiting from Turkmenistan to Russia since 2005 and from Turkmenistan to China since 2009.[2] In practice, the available export capacity is lower.

The Bukhara-Urals pipeline runs from Turkmenistan through the Bukhara gas region in Uzbekistan, via Kazakhstan to Russia. The capacity of this pipeline is 55 bcm/year; however, it does not operate at full capacity. The Central Asia-Centre is a system of natural gas pipelines that runs from Turkmenistan via Uzbekistan and Kazakhstan to Russia.

The Central Asia-China pipeline runs from Turkmenistan across Uzbekistan to southern Kazakhstan and to China. The pipeline has three parallel lines of 1 833 km and a total capacity of 55 bcm/year. In 2013, China signed agreements with Uzbekistan and other Central Asian countries to construct a 30 bcm/year fourth line of the Central Asia-China pipeline, but the project has not been realised.

Gas storage

Uzbekistan has two gas storage facilities:

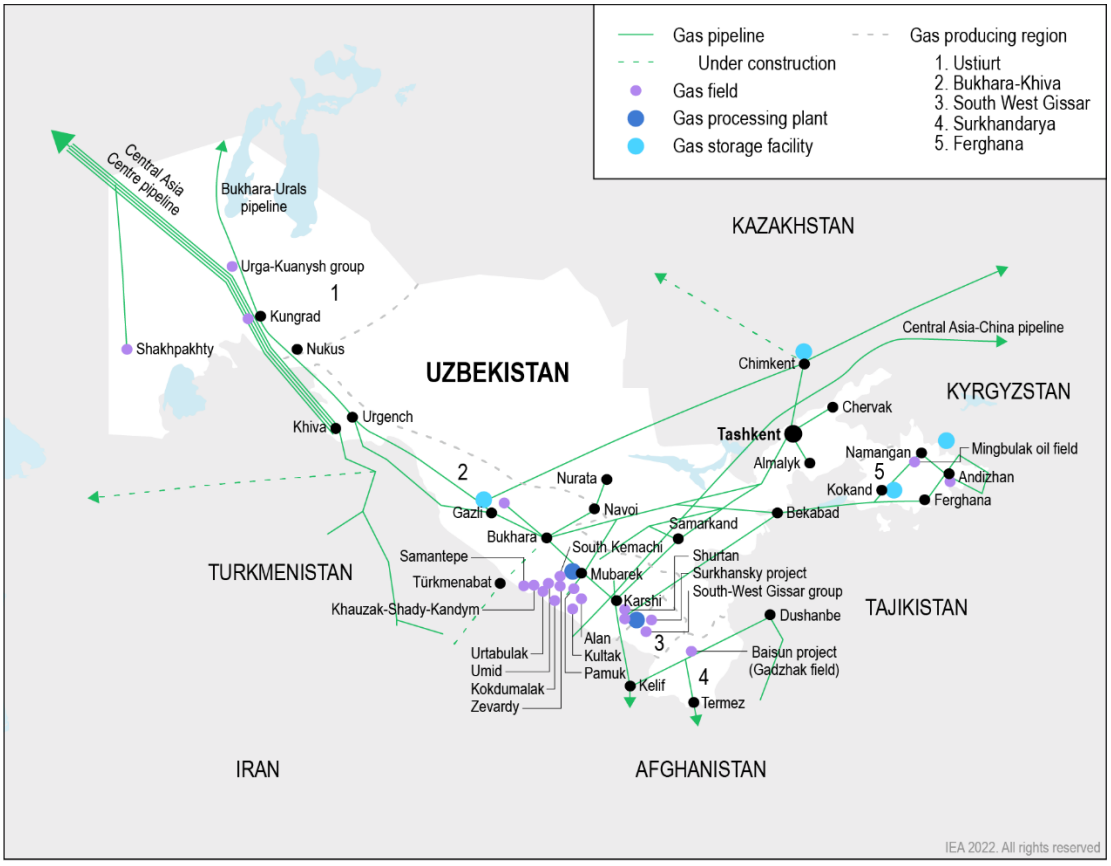
- The Gazli Gas Storage, with a 3 bcm capacity, is located in the Gazli gas field area in the Bukhara region at the intersection of the main gas pipelines Bukhara-Urals, Central Asia-Centre and Gazli-Shymkent. The facility is a JV between Uztransgaz JSC and Forus JSC, a Russian company, and has potential for expansion to up to 10 bcm.
- Khodjaabad, with a 0.9 bcm capacity, is located in the Andijan region and supplies gas for the Fergana Valley region. The facility is owned and operated by Uztransgaz JSC.

[2] For a detailed description of the pipeline system, please see the IEA 2015 review of Eastern Europe, Caucasus and Central Asia.

Investment needs to modernise gas infrastructure

Investment needs in the gas sector are expected to be significant. For example, an upgrade of the ageing gas transport and distribution system is estimated at around USD 1.5 billion. A gas master plan is under preparation to define the required investments and estimate financing needs along the entire value chain. Raising private financing would be a feasible strategy, subject to improving the financial viability and creditworthiness of the energy utilities (World Bank, 2021).

Figure 3.14 Map of Uzbekistan's oil and gas infrastructure



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

Source: Oxford Institute for Energy Studies (2019).

Gas processing and monetisation

The current natural gas processing capacity is 56.6 bcm per year, including:

- Shurtan Gas Chemical Complex, 4.0 bcm per year, operator: Uzbekneftegaz
- Shurtan Head Facility, 10.0 bcm per year, operator: Uzbekneftegaz
- Mubarek Gas Processing Plant, 30.0 bcm per year, operator: Uzbekneftegaz
- Ustyurt Gas Chemical Complex 4.5 bcm per year, operator: Uzbekneftegaz (50%) and Uz-Kor Gas Chemical (50%)
- Kandym Gas Processing Complex, 8.1 bcm per year, operator: Lukoil.

Uzbekistan, like Turkmenistan, has sought to develop petrochemicals capacity using gas as feedstock, to provide another means of obtaining value from gas that is hard to export. The Ustyurt complex was commissioned in 2015 and the Kandym complex in 2018, and petrochemicals capacity was added to the older Shurtan and Mubarek gas processing plants. Uzbekneftegaz is expanding the polymer production capacity from 125 kt to 500 kt per year at the Shurtan Gas Chemical Complex, expected to be completed by 2023. Uzbekneftegaz has also managed to reduce its gas flaring volume from 1.23 bcm in 2017 to 0.96 bcm in 2020 (Uzbekneftegaz, 2021).

A major recent addition to Uzbekistan's gas infrastructure is the Shurtan gas-to-liquids (GTL) facility. The facility processes 3.6 bcm of natural gas per year to produce 1.5 Mt of high-quality synthetic fuel complying with Euro-5 requirements. Construction commenced in 2017 and the plant was meant to be completed by August 2021 but was delayed due to the Covid-19 pandemic, and the gradual commissioning began in 2022. The GTL complex uses purified natural gas from the Shurtan Gas Chemical Complex. The USD 3.7 billion project is the largest in the history of the country's industry.

Oil refining

The two main operating refineries, Bukhara and Fergana-Alty-Aryk, have a total available production capacity of up to 5.2 Mt per year of oil products (and actual production volumes up to 2.4 Mt per year). The refineries are operating significantly below their capacity levels because of outdated technology and difficulty of obtaining crude oil supplies at competitive prices. The Fergana and Alty-Aryk refineries are linked by Uzbekistan's sole domestic crude oil pipeline.

Both the Bukhara and Fergana refineries are planned to be upgraded by 2023 to increase the refining yield and to install desulphurisation units to improve fuel quality to Euro-5 standards and to reduce direct emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds, hydrogen sulphide and particulate matter (UNECE, 2020; Uzbekneftegaz, 2021).

Table 3.1 Uzbekistan's oil refineries

Location	Name	Capacity (kb/d)	Capacity (ktpa)	Status	Start-up date	Main owner
Karaulbazar	Bukhara	50	2 489	Active	1997	Uzbekneftegaz JSC
Fergana province	Fergana (joint facility with Alty-Aryk)	110	5 500	Active	1959	Sanoat Energetika Guruhi (previously Jizzakh Petroleum)
Fergana province	Alty-Aryk (joint facility with Fergana)	66	3 287	Active	1906	Sanoat Energetika Guruhi (previously Jizzakh Petroleum)
Surkhandarya	Jarkurganneft	2.6	130	Active	2005	Jarkurganneft JSC
Tashkent province	Chinoz	2.4	117	Active	2016	Uzbekneftegaz JSC

Note: kb/d = thousand barrels per day; ktpa = kilotonnes per annum.
Sources: Uzbekneftegaz (2021), Prospectus; Upstream (2021),

Privatisation of the Fergana refinery and Uzbekneftegaz's oilfields

Uzbekneftegaz used to own the Fergana refinery complex (which includes Alty-Aryk), but in 2017, it formed a JV called Jizzakh Petroleum with Gazprom's subsidiary Gas Project Development Central Asia. The JV was 60% owned by Uzbekneftegaz and 40% by Gazprom. The JV generated several plans for refinery and petrochemicals projects, including a 5 Mt/year refinery in the Jizzakh region and a USD 2.8 billion gas-to-chemicals

complex in the Bukhara region (OGJ, 2021). The projects would have been financed through Russian banks, but they have not been realised.

In 2019, the government made plans to reduce its stake in Jizzakh Petroleum and attract foreign investors. In 2020, it ordered Uzbekneftegaz to transfer its control of 105 domestic oilfields to Jizzakh Petroleum. In March 2020, the government transferred Uzbekneftegaz's ownership in the Fergana refinery to SAMA.

In 2021, Uzbekneftegaz still owned 49% of Jizzakh Petroleum and sold this entire ownership position (Uzbekneftegaz, 2021). According to media reports, the buyer was Belvor Holding for an undisclosed amount. Belvor Holding had also managed to acquire almost the entire Gazprom stake, and now owned an estimated 98% of Jizzakh Petroleum (KUN, 2021). Belvor is a Cyprus-registered company reportedly owned by Uzbek businessman Bakhtiyor Fazylov (Upstream, 2021).

Jizzakh Petroleum was renamed Sanoat Energetika Guruhi (Industrial Energy Group in English) in 2021. In May 2022, media reports stated that SAMA sold the state ownership in Fergana Oil Refinery LLC to it for USD 100 million. Under the agreement, the buyer is committed to investing USD 380 million to modernise the facility, increase production, and begin to produce gasoline and diesel meeting the requirements of Euro-5, (KUN, 2022).

Sanoat Energetika Guruhi PE LLC is the largest private vertically integrated oil and gas company in Uzbekistan. The company currently owns 103 fields with subsoil use rights and accounts for about 80% of oil production and about 22% of proven gas reserves. In addition to oil and gas production, the company produces gasoline, diesel, LPG, aviation kerosene and a number of other high-value-added products (KUN, 2022).

There is no clear evidence of the use of competitive tenders in the privatisation of the state-owned assets in the Fergana refinery and Uzbekneftegaz's oilfields.

Financial viability of the state-owned oil and gas companies

As in all countries where the government has for long set energy prices below the cost of service, problems have emerged in Uzbekistan, directly affecting Uzbekneftegaz and Uztransgaz.

The government regulates the prices at which Uzbekneftegaz sells its natural gas and LPG. The prices do not reflect global market prices. According to November 2021 information, Uzbekneftegaz sells natural gas at USD 23 per 1 000 cubic metres (m^3) to Uztransgaz, which in turn transports it and supplies it to Khududgaztaminot, which supplies it to the general population at USD 36 per 1 000 m^3 and to consumers at prices shown in Table 3.2.

Uzbekneftegaz's upstream earnings before interest, taxes, depreciation and amortisation (EBITDA) per barrel of oil equivalent was USD 3 in 2020, one of the lowest among peers, because domestic regulated gas prices are kept low to subsidise the national economy. Nevertheless, the company generated EBITDA of USD 1 billion in 2020, due to very low lifting costs and sizeable production (Fitch, 2021). Uzbekneftegaz has received state guarantees for loans of USD 2.9 billion for its oil and gas investment, which was 85% of the total debt portfolio of the company in November 2021 (Uzbekneftegaz, 2021).

The problem for Uztransgaz, in turn, arises when it cannot source sufficient gas from Uzbekneftegaz at low prices to sell to Khududgaztaminot at a set price, but has to buy gas also from other companies in Uzbekistan, mainly Lukoil, and import it at prices much higher than its regulated selling prices.

According to media reports (Gazeta, 2022), Uztransgaz buys gas at an export price of USD 200 per 1 000 m^3 to sell it to Khududgaztaminot, which must supply the whole population at USD 36 per 1 000 m^3, the government-set price. Khududgaztaminot makes a profit, but Uztransgaz made a loss of UZS 2.51 trillion (USD 236 million at the average annual rate for 2021) in 2021, and UZS 3.57 trillion (USD 355 million) in 2020. To support Uztransgaz, the government guarantees its loans.

The low gas tariffs for customers leave Uzbekneftegaz and Uztransgaz with little funding to invest in maintenance and repair of the already outdated gas infrastructure. They also provide the customers with little incentive to use gas efficiently.

The government has not changed household gas prices since August 2019. It planned to raise electricity and gas tariffs in February-March 2020, but postponed this measure because of the coronavirus pandemic. The Central Bank, in its autumn 2021 main scenario for economy, expected regulated energy prices to be fully liberalised in 2022-2023. In June 2022, the government proposed to raise gas tariffs in all consumer categories by tens of percent.

Retail prices and tariffs

Natural gas and LPG

The government continues to set the customer prices of natural gas and LPG, but plans to deregulate them as part of the oil and gas sector reform. The Resolution of the President of Uzbekistan dated 4 November 2020 (PP-4664) provides for the setting up of a deregulated wholesale natural gas market (Uzbekneftegaz, 2021). The MEDPR published in May 2022 a draft resolution for new gas tariffs which proposes a transition to the wholesale market from 2026 (Uzbekistan, MEDPR, 2022b).

In January 2021, Uzbekistan had 7 404 000 natural gas and LPG consumers, of which 7 326 000 were households and 78 000 enterprises and other legal entities. Some 3 764 000 households were connected to the natural gas grid, while the remaining 3 640 000 households used LPG (ECS, 2022).

Natural gas supply contracts oblige all consumers to make 100% prepayments for gas. In cases when natural gas consumption exceeds the volumes indicated in the gas supply contract without preliminary co-ordination with the gas supply organisation, the consumer is charged a premium of 1.4 times for the excess natural gas offtake volumes. In the case of arrears, the consumer pays late payment interest to the gas supply organisation in the amount set by legislation.

Automatic commercial gas metering systems are being installed across the country. In January 2021, 726 000 smart meters were in use.

Gas tariffs for customers in force in June 2022 are shown in Table 3.2. The tariffs were raised most recently in August 2019 to UZS 380 (USD 0.04) per m^3 – an 18.7% rise from

the previous price of UZS 320. In the absence of a meter, 1 m^3 of gas for cooking and water heating costs UZS 660 (up 19.3% from UZS 553).

Table 3.2 Natural gas and LPG tariffs, June 2022

Category	Measurement unit	Price per unit (incl. VAT)
Residential consumers with meters	m^3	UZS 380 (USD 0.04)
Residential consumers without meters*		
- for cooking and hot water supply	m^3	UZS 660 (USD 0.07)
- for heating	m^3	UZS 380 (USD 0.04)
Automobile LPG compressor dispensing stations	m^3	UZS 1 000 (USD 0.11)
Commercial consumers	m^3	UZS 660 (USD 0.07)
LPG for households	kg	UZS 1 120 (USD 0.12)
Other wholesale customers	m^3	UZS 660 (USD 0.07)

* For consumers without meters, consumption is calculated using standard rates based on the following indicators: the number of gas-consuming appliances, number of residents, total living space, presence of livestock, etc.
Notes: VAT = value-added tax; kg = kilogramme. The tariffs have been in force since August 2019.
Source: Government Decision No. 633 of 30 July 2019.

As with the power sector, cross-subsidies also took place in the gas sector over the past decade. During 2012-2018, Uzbekistan had a single natural gas tariff for all categories of consumers. In 2019, the tariffs for legal entities were set at a level 58% higher than for residential consumers. It is estimated that in 2019 cross-subsidies amounted to USD 251 million.

As with the power sector, Uzbekistan has no special tools to support vulnerable consumers. Social policies in the gas sector are implemented by keeping tariffs below the economically justified level for all residential consumers.

The government's draft resolution for new gas tariffs from May 2022 suggests a change to this and a transition to a system of the "social norm tariff", i.e. a reduced tariff rate up to a certain maximum volume of consumption above which a free-market price applies. In practice, all tariffs would increase and help bring the sector closer to financial viability.

Around 85% of households, i.e. 3.4 million customers, consume on average up to 500 m^3 of natural gas per month. However, they account for only 35% (4.5 billion m^3) of the total consumption of the population. To rationalise the price support for households, the government carried out household consumption surveys in the Tashkent and Namangan regions and the city of Tashkent and based on them, suggested limiting the social norm tariff to 200 m^3 per month for April-September and to 700 m^3 per month for the October-March heating period (Uzbekistan, MEDPR, 2022b).

Table 3.3 shows the suggested natural gas tariffs from 1 July 2022. Tariffs for certain consumer groups would be raised again from 1 April 2023 as follows:

- The Navoi MMC, Almalyk MMC and budgetary organisations: UZS 1 350 per m^3
- Thermal power plants: UZS 1 200 per m^3
- Automobile gas compressor filling stations: UZS 1 400 per m^3
- Other legal entities: UZS 1 350 per m^3.
-

Table 3.3 Suggested natural gas and LPG tariffs from 1 July 2022

Category	Measurement unit	Price per unit (incl. VAT)
Residential consumers, October-March	m^3	UZS 380 (USD 0.035)
- for up to 700 m^3 per month	m^3	UZS 410 (USD 0.037)
- for more than 700 m^3 per month	m^3	UZS 1200 (USD 0.11)
Residential consumers, April-September		
- for up to 200 m^3 per month	m^3	UZS 410 (USD 0.37)
- for more than 200 m^3 per month	m^3	UZS 1200 (USD 0.11)
Navoi Mining and Metallurgy Combine (MMC), Almalyk MMC and budgetary organisations	m^3	UZS 1 300 (USD 0.12)
Automobile LPG compressor dispensing stations	m^3	UZS 1 200 (USD 0.11)
Thermal power plants	m^3	UZS 1 200 (USD 0.)
LPG for households	kg	UZS 1 600 (USD 0.15)
Other legal entities	m^3	UZS 1 150 (USD 0.11)

Source: Uzbekistan, MEDPR (2022b).

Oil

As of May 2020, petroleum refineries have been able to sell refined oil directly on the commodity exchange at market prices. Effective from the same date, the regulated intra-industry price for oil condensate, a by-product of natural gas extraction used in the production of heavy oil, is required to be benchmarked to the global commodity exchange price of Brent oil (World Bank, 2021). This legal basis is the Decree of the President of the Republic of Uzbekistan dated 8 October 2019, No. PP-4484, "On measures to improve the efficiency of commodity exchanges and further improve the mechanisms of exchange trading".

Because domestic resources of liquid hydrocarbon raw materials are insufficient to meet the domestic demand for petroleum products, Uzbekneftegaz imports certain amounts of liquid hydrocarbon raw materials (such as crude oil, gas condensate and gasoil) and finished petroleum products to the domestic market at global market prices. Prices of these

petroleum products on the domestic retail market are set daily based on S&P Global Platts benchmarks plus any premiums or discounts. Prices are determined on a daily basis, based on the Platt quotes and the US dollar exchange rate from the previous day (Uzbekneftegaz, 2021).

At the end of May 2022, diesel in Uzbekistan cost UZS 11 072 per litre (L) (USD 1.00) and motor gasoline UZS 9 842/L (USD 0.89). For comparison, the average price of diesel in the world for this period was UZS 14 889/L and the average price of motor gasoline UZS 15 579/L, according to the Global Petrol Prices service.

The largest filling station chain in the country is UNG Petro, with 111 stations. It is a subsidiary of Uzbekneftegaz.

Assessment

Oil and gas supply and demand

Natural gas is the backbone of Uzbekistan's energy supply. In 2020, it provided 83% of TES and 88% of electricity, according to the IEA. Oil provided 9% of TES and was primarily used for transport, but also space heating and in industry.

Natural gas demand is increasing, and the country plans to suspend natural gas exports by 2025, provide the domestic market with a full supply of uninterrupted gas, and export high-value-added gas products.

To achieve a leap in output by the end of the decade, the country urgently needs to find new reserves. The government sees fracking as a solution to realising its ambitious vision for the gas industry. Laws have been developed for PSAs and subsoil agreements and for transparent competitive tenders for allocating subsoil plots to foreign investors. The aim is to enable and attract foreign oil and gas companies and oilfield services companies to participate in oil and gas production in Uzbekistan, alongside Uzbekneftegaz.

As domestic oil and gas production has not kept pace with rising demand, Uzbekistan has seen its export status diminish and in the past couple of years turned into a net importer of both oil products and gas. In this new situation, even if it will prove temporary, the government should make plans for maintaining security of supply.

Climate policy is not a priority in Uzbekistan's energy sector plans, as the government focuses on security of supply and economic growth. However, using gas and oil more efficiently would also reduce GHG emissions, and the country could even look for international carbon financing for such projects as it has successfully done in the past. Methane leaks from outdated natural gas pipelines are the single largest source of Uzbekistan's GHG emissions and tackling them will help improve the country's energy security and the sector's financial viability. Another, but smaller, area of multiple benefits is to further reduce gas flaring which still amounts to around 1 bcm per year (see Chapter 8),

Oil and gas reform

The government is carrying out reform in the oil and gas sector. Until 2019, the government of Uzbekistan owned and managed the sector through Uzbekneftegaz. The vertically

integrated company covered oil and gas exploration, extraction, processing, distribution, storage, refinery, and retail services.

According to the Decree of the President of the Republic of Uzbekistan No. 4388 of 9 July 2019 "On measures for stable provision of economy and population with energy resources, financial recovery, and improvement of oil and gas industry management system", JSC Uztransgaz was separated from JSC Uzbekneftegaz and further divided into two independent JSCs – Uztransgaz and Khududgaztaminot. Uzbekneftegaz was also restructured.

Uztransgaz JSC is the gas TSO. It also purchases natural gas from extraction and processing companies, including joint ventures and foreign companies operating on the basis of PSAs. It sells the gas to large consumers directly connected to its high-pressure gas network and to consumers under commission agreements with Khududgaztaminot and to consumers connected to gas distribution networks.

JSC Khududgaztaminot is the gas DSO and gas supplier to customers. It also purchases, supplies, stores and sells LPG to the population and social facilities.

Strengthening the gas sector's financial sustainability is critically important for Uzbekistan. The necessary elements include cost-recovering tariffs, social assistance to the poor to mitigate the impact of tariff reforms, reduction in technical and commercial losses, higher energy efficiency in gas supply and consumption, improved financial transparency and reporting of the sector utilities, access to commercial financing, and robust communication campaigns (World Bank, 2021).

The government plans to privatise minority shares of state-owned companies in the oil and gas sector. Selling shares in individual companies will bring in revenue, but not increase competition in the energy market. Divesting of selected assets through competitive and transparent tenders, in contrast, would offer an opportunity to attract new entrants to increase competition and therefore market efficiency.

Petrochemicals sector development

The government plans to develop the petrochemicals sector to create value-added products out of local hydrocarbons instead of directly exporting them. In 2020, the "Concept of provision of oil and gas products of the Republic of Uzbekistan for 2020-2030" was approved. Also, the important law on gas supply is being developed.

Strategic facilities such as the Ustyurt Gas Chemical Complex, the Kandym Gas Processing Complex and a number of others have become operational since the mid-2010s, and implementation of major strategic projects on deep hydrocarbon processing continues.

Based on the recommendations of international consultancies, Uzbekistan is focusing the development of its oil and gas industry on petrochemicals production. The aim is to increase petrochemicals production to initially replace oil product imports, but later also to increase their exports to Central Asia and bring more revenue to the country. Also, petrochemicals are a strategic sector to develop in Uzbekistan's economy and the government sees them as very promising for stable growth.

The GTL Uzbekistan Gas Chemical Complex, launched in December 2021, synthesises around 1.5 Mt of liquid hydrocarbons received from 3.5 bcm of purified natural gas of the

Shurtan Gas Chemical Complex to produce 730 kt of diesel, 300 kt of kerosene (jet fuel) and 430 kt of naphtha. These products are mostly directed to cover national demand and reduce the need for imports.

The Shurtan complex produces 387 kt of polyethylene and 100 kt of polypropylene and processes around 4.5 bcm of gas. The other three facilities are Ustyurt Gas Chemical Complex, Kandym Gas Processing Plant and the Bukhara Oil Processing Plant.

Capacity is being expanded at the Shurtan and GTL Uzbekistan complexes by adding small-sized plant units. The government considers it more viable to focus on small plants to diversify the list of products to be exported to the Central Asian region. Providing regulatory and fiscal incentives is key to attracting more investments in the petrochemicals sector.

Retail oil and gas

Retail price regulation of oil products was abolished in May 2020, and oil refineries sell their products only through exchange trading. This is a very welcome development.

Gas tariffs continue to be regulated at very low levels, but in June 2022, the government proposed a new tariff structure that would improve the situation. It would in general increase the tariffs, but also set a maximum volume for gas supply at a still strongly subsidised price. This would be a welcome step in the gradual transition to fully deregulated prices by 2026.

Transitioning gradually to a liberalised domestic gas market is the right way to go. In the interest of transparency, the government should introduce an independent regulator for the sector and grant it the legal right to take binding decisions and issue gas market rules and network codes, including on tariffs.

The level of ambition and the pace of reform need to be consistent with electricity market reform measures, given that subsidised gas is the dominant fuel for electricity production and that low tariffs on gas used for power generation make renewable energy and efficiency measures less appealing. Even lower gas prices for households disincentivise other heating options, such as heat pumps and DHC (see Chapter 5).

Regardless of how open the market is, it is essential that regulations enable operational profitability. As in many other producer countries and former Soviet Union countries, Uzbekistan's government has subsidised citizens and businesses by providing low-cost energy in the form of oil, natural gas, electricity and district heat. This tariff policy leads to the inefficient use of natural resources that could (and should) be better used elsewhere.

The IEA strongly encourages the government in its efforts to move to deregulated gas prices in the next few years. The availability of artificially inexpensive CNG encourages citizens to purchase large and energy-inefficient vehicles, and the impacts of this policy will become more significant – and the implied subsidies larger – as the car fleet continues to expand. Gas subsidies also help gas outcompete other, potentially more efficient, options for generating heat and electricity (see Chapters 4 and 5). Gas tariffs that do not cover costs not only constrain Uzbekneftegaz and Uztransgaz financially, they undermine incentives to improve gas networks and, if markets are opened to competition, discourage new entrants.

To help improve the financial viability of the oil and gas sector, and that of Uzbekistan's domestic energy supply in general, the government should gradually eliminate state-owned energy companies' involvement in social protection and employment policy. Instead of subsidising gas prices for all consumers, the government should provide direct support to low-income and vulnerable ones. Paying a fair market price would motivate consumers to use energy more efficiently and provide a clear incentive for suppliers to improve productivity. This would also leave more oil and gas to be used for higher-value-added petrochemicals.

Recommendations

The government of Uzbekistan should:

- Manage costs especially for new upstream developments to keep the sector competitive, focusing on collaborative access to resources and contracting strategies as well as local capability development, notably in digital technologies.
- Take steps to attract the world's leading energy companies to the upstream and downstream activities of the oil and gas sector in order to benefit from technology, know-how, knowledge and skills transfer.
- Review the corporate development strategies of the state-owned oil and gas companies to increase their transparency and accountability and improve their corporate governance.
- Ensure independent natural gas regulation according to best practices and liberal market principles; prepare the necessary primary and secondary legislative acts related to network and retail tariff regulation and governance of the natural gas field.
- Increase the role of the private sector in the production and distribution of natural gas and create a competitive environment.
- Continue to modernise the gas network infrastructure to prevent losses and increase its efficiency.
- Consider the application of natural gas block tariffs for households to encourage more rational and efficient gas use.

Petrochemicals

- Develop a strategy to become a leading petrochemicals supplier in the Central Asian region and diversify its product portfolio to respond to projected demand.
- Consider providing long-term regulatory and fiscal stability in the form of legislation or special investment agreements for the sector to attract investment, including investment protection and fiscal incentives.
- Develop strategies and mechanisms to ensure an uninterrupted supply of oil and gas to the petrochemicals sector.
- Continue to improve the infrastructure of the petrochemical complexes and provide safe and technologically proven ways of transportation.

References

BP (2021), *Statistical Review of World Energy 2021*, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf.

ECS (Energy Charter Secretariat) (2022), *In-Depth Review of the Energy Efficiency Policy of the Republic of Uzbekistan*, https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Uzbekistan_2022__en.pdf.

Fitch (2021), Fitch Rates Uzbekneftegaz USD700 million Notes Final 'BB-', 16 November 2021, https://www.fitchratings.com/research/corporate-finance/fitch-rates-uzbekneftegaz-usd700-million-notes-final-bb-16-11-2021.

Gazeta (2022), The head of Uztransgaz explained the losses of UZS 5 trillion, 17 May 2022, https://www.gazeta.uz/ru/2022/05/17/uztransgaz/.

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

Kosta Legal (2020), Risk Service Contracts in Uzbekistan, https://kostalegal.com/legal-alerts/risk-service-contracts-in-uzbekistan.

KUN (2022), Fergana Oil Refinery sold to a private company for USD 100 million, 23 May 2022, https://kun.uz/en/news/2022/05/23/fergana-oil-refinery-sold-to-a-private-company-for-100-million.

KUN (2021), Uzbekneftegaz resigns as one of the founders of Jizzakh Petroleum, 29 October 2021, https://kun.uz/en/news/2021/10/29/uzbekneftegaz-resigns-as-one-of-the-founders-of-jizzakh-petroleum.

OGJ (Oil and Gas Journal) (2021), Jizzakh Petroleum inks MOU for financing of Uzbekistani methanol-to-olefins, 4 June 2021, https://www.ogj.com/refining-processing/gas-processing/new-plants/article/14204650/jizzakh-petroleum-inks-mou-for-financing-of-uzbekistani-methanoltoolefins.

OIES (2019) (Oxford Institute for Energy Studies), Central Asian gas: Prospects for the 2020s, *OIES Paper*, NG 155, https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2019/12/Central-Asian-Gas-NG-155.pdf.

S&P Global (2020), Interview: Uzbekistan sees gas output at around 60 Bcm in 2020, 2021, 4 December 2020, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/120420-interview-uzbekistan-sees-gas-output-at-around-60-bcm-in-2020-2021.

United Nations (2022), Comtrade database, https://comtrade.un.org/data/.

UNECE (United Nations Economic Commission for Europe) (2020), Environmental Performance Reviews: Uzbekistan, Environmental Performance Reviews Series No. 52,

https://unece.org/environment-policy/publications/3rd-environmental-performance-review-uzbekistan.

Upstream (2021), Russian banks extend new loan to Uzbekneftegaz despite assets loss, 23 November 2021, https://www.upstreamonline.com/production/russian-banks-extend-new-loan-to-uzbekneftegaz-despite-assets-loss/2-1-1103566.

Uzbekistan, MEDPR (Ministry of Economic Development and Poverty Reduction) (2022a), Information on reforming the energy sector, https://mineconomy.uz/ru/news/view/4599.

Uzbekistan, MEDPR (Ministry of Economic Development and Poverty Reduction) (2022b), Explanatory note to the draft Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On the use of prices for fuel and energy resources", https://mineconomy.uz/ru/news/view/4616.

Uzbekneftegaz (2021), Prospectus, 12 November 2021, https://webdev.ung.uz/media/allfiles/files/f04f93d871004f4f8576f7750371d09e.PDF.

UzStat (The State Committee of the Republic of Uzbekistan on Statistics) (2022a), Production and consumption of natural gas, https://api.stat.uz/api/v1.0/data/tabiiy-gazni-qazib-chiqarish-va-istemoli?lang=en&format=pdf.

UzStat (2022b), Oil and gas condensate production, https://api.stat.uz/api/v1.0/data/neft-va-gaz-kondensati-qazib-chiqarish?lang=en&format=pdf.

UzStat (2022c), Pilot fuel and energy balance of the Republic of Uzbekistan for 2020, https://api.stat.uz/api/v1.0/data/2020-yil-uchun-ozbekiston-respublikasi-yoqilg?lang=en&format=pdf.

World Bank (2021), *Assessing Uzbekistan's Transition: Country Economic Memorandum*, https://openknowledge.worldbank.org/handle/10986/36655#:~:text=Uzbekistan%E2%80%99s%20transition%20from%20planning%20to%20market%20started%20almost,prevailing%20at%20the%20time%20of%20the%20planned%20economy.

4. Coal

Key data

(2020 provisional)

Coal production: 4.1 Mt (0.26 Mt anthracite, 3.87 Mt lignite), +13.9% since 2010

Coal imports: 3.0 Mt (negligible in 2010)

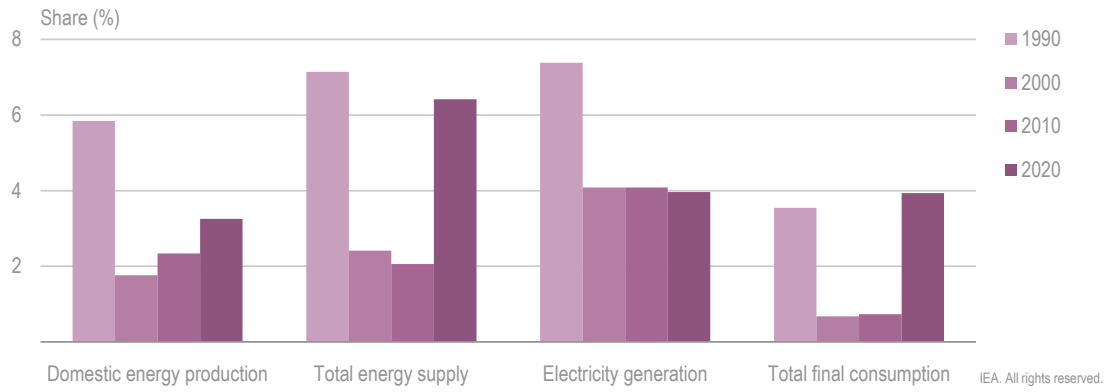
Share of coal: 3.3% of domestic energy production, 6.4% of TES, 4.0% of electricity generation, 3.9% of TFC

Coal consumption by sector: 2.7 Mtoe (electricity and heat generation 51.2%, residential 9.7%, industry 8.5%, other/unspecified 30.5%), +168.8% since 2010

Overview

Coal's role in Uzbekistan's energy system is limited. Despite doubling since 2010, its share in TES is still in single digits. Most coal is transformed to electricity, amounting to around 4% of electricity generation. Final consumption of coal has increased rapidly since 2010 but from a very low base. Domestic coal production has not been able to respond to the increased demand, so Uzbekistan has resorted to coal imports that in 2020 covered 37% of the supply.

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



Coal's importance in Uzbekistan's energy system is low.

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

As part of Uzbekistan's economic reforms, a coal sector development and modernisation programme for 2017-2021 was adopted in June 2017. The programme provided for

replacing coal imports by increasing domestic coal production in new or modernised mines. The current programme for 2020-2024 aims to substantially increase coal production, up to 13 Mt per year, which would eliminate the need for coal imports.

Resources

Uzbekistan's current coal resource base is the Angren lignite deposit and the two smaller Shargun and Boysun hard coal deposits. Uzbekistan's proven coal reserves (essentially the coal deposits likely to be economically recoverable) amount to 1.4 billion tonnes (Gt), along with another 9.5 Gt of resources (the total amount of coal likely to be in the ground, but not economically recoverable) (BGR, 2022). The government puts the Angren lignite reserves at 1.765 Gt. It estimates the hard coal reserves in Shargun to be 45.7 Mt and in Boysun 12.9 Mt.

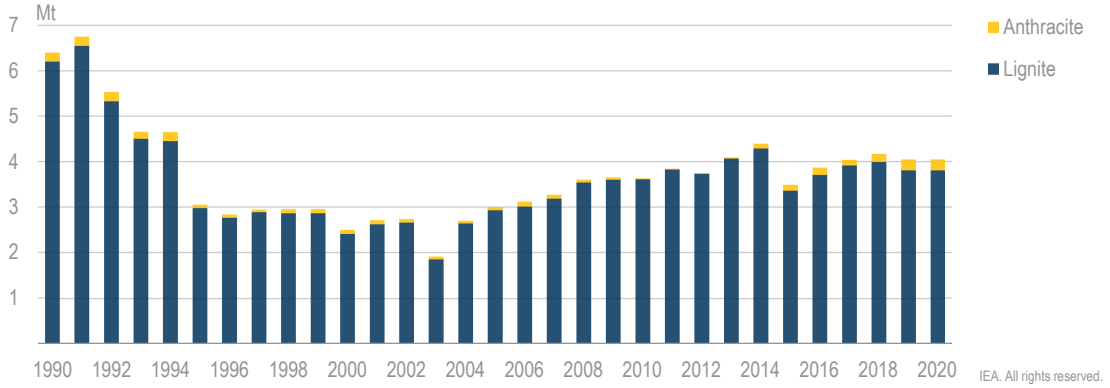
Supply and demand

Production

Uzbekistan's coal production stood at 4.1 Mt in 2020, up around 14% from 2010. Coal is mined by the state-owned Uzbekugol. More than 90% of the production is lignite (brown coal) from the Angren and the adjacent much smaller Apartak open-pit mines. The company expects to produce 4.8 Mt of lignite in both 2022 and 2023. Uzbekugol also mines hard coal In the Shargun and Boysun underground mines.

Coal production is set to increase under the coal sector development and modernisation programme for 2020-2024. The initial plan was to reach 13 Mt in 2024, of which 3.2 Mt is from an entirely new Nis-Bash underground mine, but that target seems unlikely to be met (Uzbekistan, 2019). Uzbekugol plans to increase lignite production to 9 Mt in 2026. Production at Shargun is being expanded to up to 1 Mt in a joint project with the China Railway Tunnel Group and China Coal Technology & Engineering Group Corp, funded mainly from Chinese sources.

Figure 4.2 Uzbekistan's coal production, 1990-2020



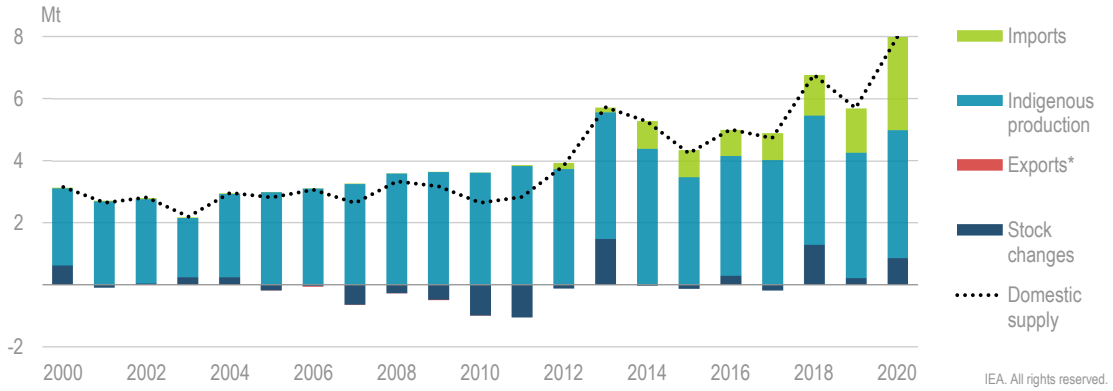
Coal production has been relatively stable in the last decade.

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

Trade

Uzbekistan started importing coal in notable quantities in 2014, mainly from Kazakhstan. The share of imports in total demand has grown from negligible in 2010 to 37% in 2020. Uzbekugol's selling price, which is set by the government, for power plants is USD 20 per tonne (t) to USD 22/t, with transport USD 27/t, while the higher-quality Kazakh coal costs USD 30/t.

Figure 4.3 Uzbekistan's coal supply, 2000-2020



Coal trade represents only a fraction of the supply.

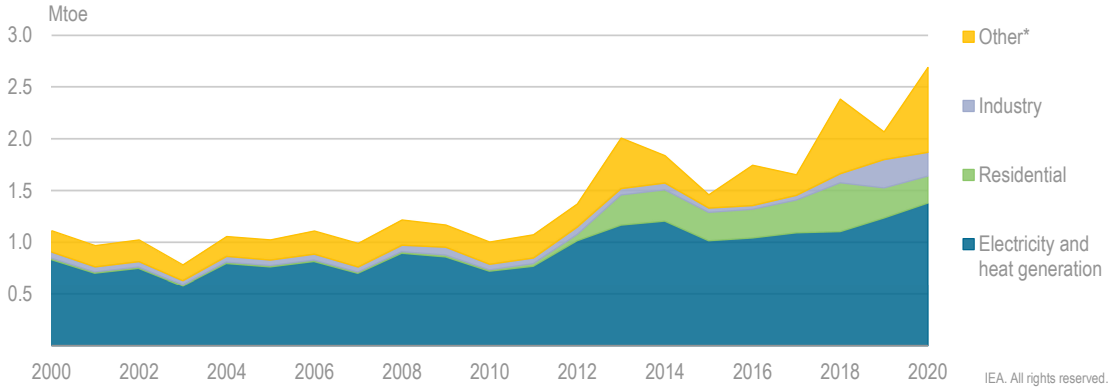
* Not visible at this scale.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Consumption

Coal demand was 2.9 Mtoe (8.0 Mt) in 2020, almost a three-fold increase from 2010 (+169%). Lignite accounts for 85% of the demand, the rest consisting of hard coal. Most coal (51% of the total) was used for electricity and heat production, 10% by the residential sector and 9% in industry. A large part of coal consumption is unallocated to any sector (31%).

Coal use in households has increased since 2014 when Uzbekistan began to produce coal briquettes. They are supplied at subsidised prices mainly to the rural population outside of the gas network, but also to public-sector users, such as schools and hospitals (ECS, 2022).

Figure 4.4 Coal demand by sector, 2000-2019



Coal is mainly converted to electricity and heat.

* Consists mainly of unspecified energy consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Assessment

Coal is a minor fuel in Uzbekistan's gas-dominated energy supply. In 2020, it provided 6.4% of TES and 4% of electricity generation. Uzbekistan's proven coal reserves amounted to 1.4 Gt in 2020.

Coal is mined by the state-owned Uzbekugol. The company's main asset is the Angren open-pit lignite mine, where it expects to produce 4.8 Mt of lignite in both 2022 and 2023. In addition, the Shargun underground hard coal mine is being expanded with Chinese investment. It is expected to produce up to 1 Mt per year in the near future.

Domestic production does not meet all coal demand, and Uzbekistan imports around 2 Mt of coal per year (according to IEA data), mainly from Kazakhstan. Local coal is lignite, often of half the calorific value of imported coal. Uzbekugol plans to dry its coal to raise its calorific value. It also plans to increase coal mining at Angren and Shargun to cover all domestic demand in the next few years. Currently, the company employs around 6 000 miners (plus 1 500 people in other positions, such as sales). To produce the planned 8 Mt per year, the company estimates it will need 1 500 miners more. By international standards, this implies low productivity.

Coal is used mainly at the two power plants next to the Angren mine, which generate around 2 TWh per year. The generating capacity is being modernised and increased by Chinese companies. The plants belong to the state-owned JSC Thermal Power Plants, and the government sets its power prices. Uzbekugol estimates that in a free electricity market, coal-fired thermal power plants would be less competitive than gas-fired ones. This, however, appears to assume that the gas price for electricity generation in the country remains extremely low.

Coal is also used in the cement industry and by households. Some coal is supplied to households in remote regions in a form of social policy at subsidised prices set by the Ministry of Finance. In 2018 and 2019, brick production and greenhouses switched from gas to coal in a government-led effort to save gas for higher-value exports and petrochemicals production.

The future of coal in Uzbekistan will be defined by its competitiveness in an open electricity market and its capacity to meet air quality and GHG emission targets that are gradually becoming stricter. Both call for an end to any possible coal production subsidies. Increasing coal production that requires subsidies would also only increase the eventual need for assistance to coal mine workers if the mines were shut down.

It will also be wise to refrain from increasing coal-fired power capacity until there is more clarity on its competitiveness in an open electricity market. It will in any case be much easier for Uzbekistan to attract broad international investment in clean energy than in coal, where China has remained practically the only source of international funding and even that source may be drying up as President Xi Jinping announced in September 2021 that China will not build more coal plants abroad. Air pollution is a real issue in Uzbekistan and to fight it, tight air quality regulations will need to be introduced and enforced also at power plants.

Coal has clear benefits for energy security, but to meet its energy security objectives, Uzbekistan has plenty of other options available. For electricity sources, these include natural gas, hydropower and a huge potential for solar and wind power. Better electricity

market design and measures to promote cross-border integration, grid storage and higher plant efficiency could also help maintain electricity supply security while meeting future air quality and emissions targets. There may be an electricity security case for keeping the most efficient or systemically important coal-fired units in a power generation reserve to respond to seasonal variations and unexpected contingencies, however. Cleaner energy sources are also available for households and most manufacturing industries.

Recommendations

The government of Uzbekistan should:

- Avoid any possible subsidies for coal production.
- Adopt and enforce strict air pollution control for coal-fired power plants.
- Refrain from increasing coal-fired power capacity to meet gradually tightening limits for air pollution and GHG emissions and use other options to ensure electricity supply security.
- Start planning for the economic transformation in coal-mining regions that will eventually be affected by reduced or discontinued coal production, with a view to developing alternative sources of employment.

References

BGR (Bundesanstalt für Geowissenschaften und Rohstoffe [Federal Institute for Geosciences and Natural Resources]) (2022), *BGR Energiestudie 2021*, https://www.bgr.bund.de/DE/Themen/Energie/Downloads/energiestudie_2021.pdf;jsessionid=4C86EB6E210BAF67BA7F0F57D4D4F2FA.2_cid331?__blob=publicationFile&v=4.

ECS (Energy Charter Secretariat) (2022), *In-Depth Review of the Energy Efficiency Policy of the Republic of Uzbekistan*, https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Uzbekistan_2022__en.pdf.

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

Uzbekistan, Resolution of the President (2019), On measures for further comprehensive development and improvement of the coal industry of the Republic of Uzbekistan, ID-3767, https://regulation.gov.uz/uz/document/3767.

5. Electricity, including district heating

Key data

(2020 provisional)

Total electricity generation: 66.5 TWh (natural gas 87.8%, hydro 7.5%, coal 4.0%, oil 0.7%, solar and wind negligible), +27.9% since 2010

Total installed capacity: 15.9 GW (13.9 GW TPP and co-generation*, 2.0 GW HPP)

Electricity net imports: 2.5 TWh (imports 5.2 TWh, exports 2.7 TWh)

Electricity consumption: 56.2 TWh (industry 35.1%, residential 27.7%, agriculture 18.4%, services 9.3%, energy sector own use 7.6%, transport 1.9%), +34.4% since 2010

* Co-generation refers to the combined production of heat and power.

Overview

Uzbekistan's electricity supply relies on the country's ample natural gas resources. The electricity system is dominated by state-owned monopolies, and the government sets all wholesale and retail prices.

Electricity market reform is being undertaken to ensure the ability to meet fast-growing electricity demand, improve the quality of electricity supply service, attract private-sector investment and increase efficiency. A new electricity market law and other legal instruments have been drafted and are awaiting approval. A market regulator will be set up. End-user tariff reform is central to reform efforts to encourage investments needed to modernise and expand generating capacity and networks.

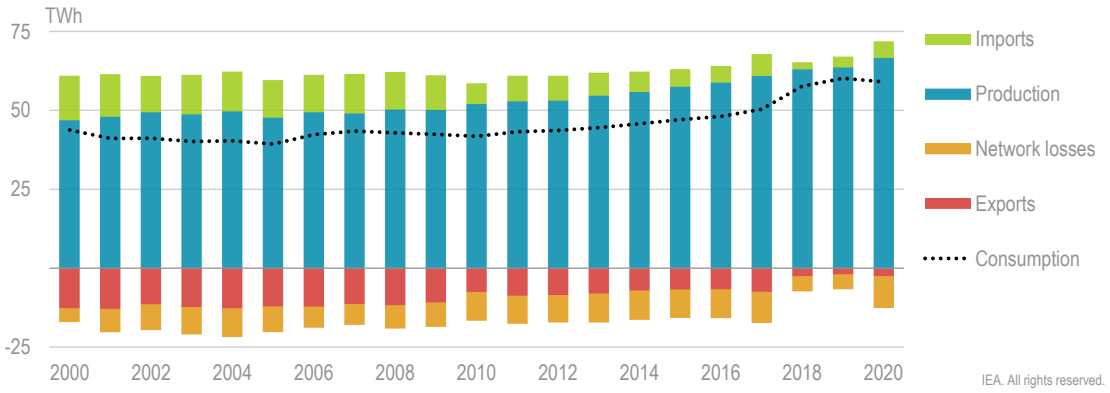
Meanwhile, the country's significant solar and wind power potential is planned to be harnessed to meet several energy policy goals simultaneously, including to reduce reliance on natural gas, which the government sees as bringing higher value-added in petrochemicals production. The government set in 2019 a target for renewable energy to provide 25% of electricity supply by 2030, more than twice the current share. Uzbekistan also has plans to build nuclear power capacity and increase domestic coal use for power generation. The government expects total electricity generation to roughly double to 120 TWh by 2030.

Supply and demand

Over the past ten years, the growing electricity demand has been covered by the supply from gas-fired power plants. They are being gradually modernised and new combined-cycle plants are being commissioned. in 2016, a combined-cycle gas turbine (CCGT) unit with an installed capacity of 370 megawatts (MW) was added to the Tashkent Thermal Power Plant (TPP); in 2012 and 2018, CCGTs with capacities of 478 MW and 450 MW were commissioned at the Navoi TPP, while a comprehensive reconstruction of the Syrdarya TPP is under way (the modernisation of units No. 3 and No. 4 was completed in January 2020 and the TPP's capacity reached 3 100 MW, the highest in Central Asia).

In 2020, gross electricity consumption per capita was 2 000 kWh/person per year (up 12.6% from 2010), well below the world average of 3 260 kWh/person. Further widespread electrification of final consumption poses challenges to the energy system of Uzbekistan and necessitates its advanced development.

Figure 5.1 Uzbekistan's electricity supply, 2000-2020



Uzbekistan's electricity supply reached a record high in 2020 and is set to grow fast this decade.

Notes: Data for network losses until 2017 may include electricity consumed by the power plants.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Generation

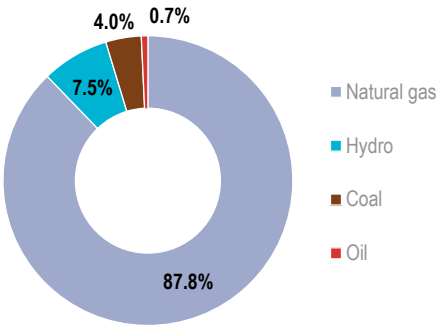
In January 2021, Uzbekistan had 15.9 gigawatts (GW) of electricity generating capacity, of which 12.9 GW were available. The main source of generation are 11 TPPs with a capacity of 13.9 GW and hydropower plants (HPPs) with 1.85 GW (Table 5.1).

Today, 3.9 GW (27.2% of the total capacity of TPPs) falls on the energy-efficient power units commissioned in 2012-2021, and 1.9 GW (13.7% of the total capacity of thermal power plants) are modernised. The rest of the thermal power capacity – 8.4 GW (60%) – was put into operation in the 1970s and 1990s; they operate on natural gas, heating oil and coal (wear-out on average 64%), with an efficiency of 25-35%, or half the efficiency of contemporary CCGTs. Within HPPs, 50% of the capacities are new and/or modernised (ADB, 2019).

While natural gas continues to dominate electricity generation, electricity demand is growing, and a policy to diversify energy sources for electricity is being implemented. The government plans to significantly increase the use of renewable energy as well as develop nuclear power plants and coal-fired generation.

Fifteen new energy projects with a total capacity of 5.8 GW (including 1.7 GW of wind and solar power) are under way, and planned investments amount to USD 5.2 billion. The average age of TPPs was 42 years, co-generation plants 63 years and large HPPs 46 years.

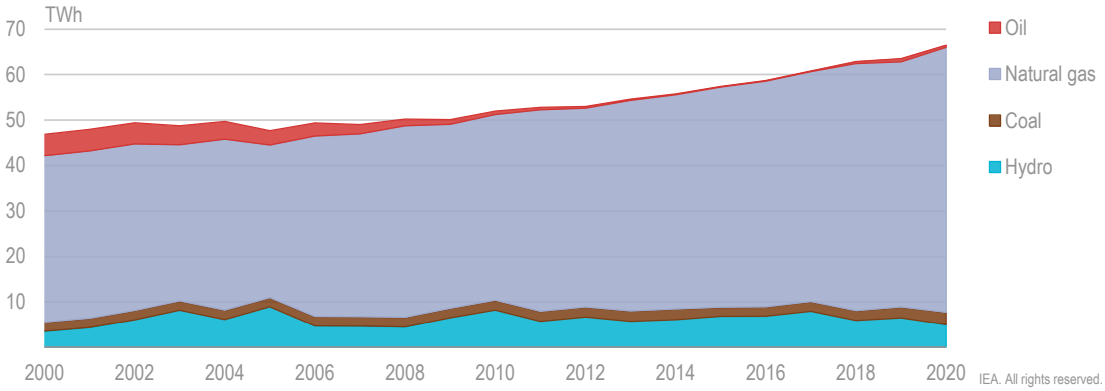
Figure 5.2 Electricity generation by source, 2020



Natural gas continues to dominate Uzbekistan's electricity generation, but the government is targeting 25% of renewable electricity by 2030.

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

Figure 5.3 Electricity generation by source, 2000-2020



Electricity generation is set to continue to grow every year and, according to government projections, reach 120 TWh in 2030.

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

Table 5.1 Power plants in Uzbekistan, 2021

N°	Name	First unit commissioned in	Installed capacity, MW	Share of total, %
Thermal power plant (coal, gas)				
1	JSC Angren TPP	1957	393	2.6%
2	JSC Novo-Angren TPP	1985	2 100	13.9%
Thermal power plant (gas, fuel oil)				
3	Unitary enterprise Tashkent TPP	1963	2 230	14.1%
4	JSC Navoi TPP	1964	2 068	13.1%
5	JSC Takhiatash TPP	1967	910	5.7%
6	JSC Syrdarya TPP	1972	3 165	20.0%
7	UE Talimarjan TPP	2004	1 700	10.7%
8	UE Turakurgan TPP	2019	900	5.7%
	Total TPP		13 466	85.0%
Co-generation plant (gas, fuel oil)				
1	JSC Tashkent co-generation plant	1934	57	0.4%
2	JSC Fergana co-generation plant	1956	312	2.0%
3	JSC Mubarek co-generation plant	1985	60	0.4%
	Total co-generation		429	2.7%
Hydropower plant				
	UE Cascade of Chirchik HPPs, including:			
1	Tavaksay HPP (HPP-8)	1941	72	0.5%
2	Chirchik HPP (HPP-7)	1940	84	0.5%
3	HPP Ak-Kavak (HPP-10)	1943	35.1	0.2%
4	UE Farkhad HPP	1948	126	0.8%
	UE Cascade of Urta Chirchik HPPs, including:			
5	Charvak HPP (HPP-6)	1970	666	4.2%
6	Khodzhikentskaya (HPP-27)	1975	165	1.0%
7	Gazalkent HPP (HPP-28)	1980	120	0.8%
8	Andijan HPP	1983	140	0.9%
9	Tuyamuyunskaya HPP	1983	150	0.9%
10	Tupolangskaya HPP	2006	30	0.2%
11	Andijan HPP-2	2010	50	0.3%
12	Hissarak HPP	2011	45	0.3%
	Total HPP (>30 MW)		**1 683**	**10.6%**
	Total small HPPs (< 30 MW), 29 stations	**1926-2019**	**256**	**1.6%**
	Total HPP		**1 939**	**12.2%**
	Total for the energy system		**15 834**	**100.0%**

Source: Energy Charter Secretariat (2022), In-depth Review of the Energy Efficiceny Policy of the Republic of Uzbekistan.

The Electricity Supply Security Concept for 2020-2030 envisages the construction of six TPPs with a total capacity of 3.8 GW and the reconstruction of six operating ones with an increase in capacity by 4.1 GW. In particular, it is envisaged to build regulating power plants to cover the peak loads of the electricity system with a total capacity of about 1.2 GW of gas turbine plants and gas engines. The coal-fired Novo-Angren TPP is also envisaged to be modernised to increase its capacity by 330 MW.

In 2022, power plants are being constructed with public-private partnerships, mainly with Turkish investors. Thus, projects worth USD 705 million have already been implemented by Turkish companies Aksa Enerji, Odaş Enerji CA and Cengiz Enerji with a total capacity of 1 154 MW on natural gas (Uzbekistan MoE, 2022a).

The Electricity Supply Security Concept for 2020-2030 emphasises the development of renewable electricity, especially 5 GW of solar power and 3 GW of wind power. The development of solar photovoltaic (PV) systems with a capacity of 100 MW to 500 MW is considered mainly in the central and southern regions (Jizzakh, Samarkand, Bukhara, Kashkadarya and Surkhandarya regions). However, solar PV power plants with a capacity of 50 MW to 200 MW will also be built in other regions. Wind power will be mainly constructed in the form of large 100 MW to 500 MW wind farms, mostly in the north-western region (see Chapter 6, Renewable energy). In 2021, in its updated NDC under the Paris Agreement, Uzbekistan raised the targets for solar and wind generation capacity to 8 GW by 2026 and 12 GW by 2030 (7 GW solar, 5 GW wind).

The Decree of the President of the Republic of Uzbekistan, dated 10 December 2021, No. PP-44 "On additional measures for the further development of hydropower" (Uzbekistan President, 2021), sets out a plan to increase Uzbekistan's hydropower capacity to 3 416 MW in 2030 (an increase of 1 477 MW) by phased modernisation of HPPs and new construction. The largest projects are the modernisation of the Tupolangskaya HPP to increase capacity by 145 MW, the construction of the 400 MW Pskemskaya HPP, and the construction of the 200 MW Khodjikent pumped storage plant.

The development of nuclear energy is also planned. On 7 September 2018, the governments of Uzbekistan and Russia signed an agreement to co-operatively construct a nuclear power plant in Uzbekistan. The document provides for the construction of a 2.4 GW Generation III+ nuclear plant with two VVER-1200 light-water power reactors for around USD 11 billion. The site selected is near the Lake Tuzkan Aidar-Arnasai system of lakes. In accordance with Presidential Decree No. PP-4165 of 7 February 2019, the Concept for the Development of Nuclear Power in Uzbekistan for 2019-2029 and the roadmap for its implementation were approved. Law No. ZRU-565 of 9 September 2019 "On the use of atomic energy for peaceful purposes" was also adopted.

Imports and exports

Uzbekistan's electricity system is connected to the other Central Asian countries and, through Kazakhstan, to Russia through 220 kilovolt (kV) and 500 kV lines, and to Afghanistan by 220 kV lines. The small Lochin station in the Fergana Valley is connected to Kyrgyzstan's power system by a 500 kV line. Seven 220 kV and two 110 kV cross-border networks operate in the Valley regions. In addition, 220 kV and 500 kV lines from the Tashkent TPP connect the power systems of Kazakhstan and Uzbekistan, ensuring their mutually co-ordinated operation.

Uzbekistan's cross-border capacity is at 4 150 MW or 27.6% of the country's installed capacity: 1 000 MW with Kazakhstan, 850 MW with Tajikistan, 450 MW with Afghanistan, 850 MW with Turkmenistan, and 1 000 MW with Kyrgyzstan.

The net electricity trade has remained relatively balanced close to zero until 2019, when Uzbekistan turned clearly a net importer of electricity. Uzbekistan has traditionally exported gas-fired electricity in winter months and imported hydropower during summer. In 2021, Uzbekistan exported 2.15 TWh, mainly to Afghanistan, and imported 6.2 TWh, mainly from Tajikistan and Kyrgyzstan, according to the National Electricity Grid of Uzbekistan JSC (NEGU, 2022).

Figure 5.4 Electricity transmission network of Central Asia

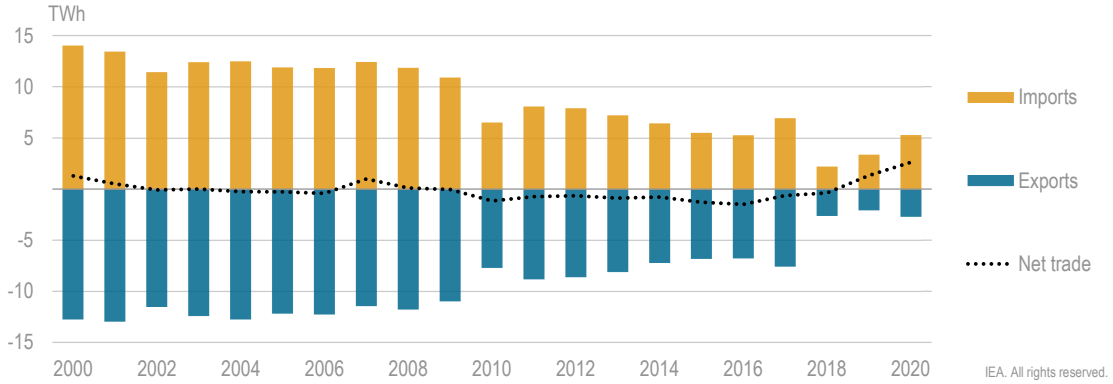
This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: USAID (2015), Central Asia Electric Grid.

Since 2019, Tajikistan has exported electricity to Uzbekistan through Surkhandarya province and imported it to Khujand province in Tajikistan through Syrdarya province, indicating that the countries are connected to a single-network electricity system. Uzbekistan currently has 220 kV and 500 kV lines, and Tajikistan is implementing projects to use emergency automatics and relay protection.

In August 2020, the government of Uzbekistan signed a ten-year agreement with the Afghanistan government for electricity export, including the construction of a 500 kV interconnection line, which could help increase the net electricity exports from Uzbekistan.

Figure 5.5 Uzbekistan's cross-border electricity trade, 2000-2020



Uzbekistan has recently become a net importer of electricity.

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

Box 5.1 Uzbekistan and the Central Asian Power System

The five Central Asian countries – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan – shared a unified energy grid in the last decades of the Soviet Union. Today, the power systems of Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan are interconnected by 220 kV and 500 kV lines with the Central Asian Power System (CAPS), and in July 2019 all five Central Asian states and Afghanistan signed an agreement to connect their electric grids and unify their electricity markets. CAPS operates in parallel with the UES of Russia to which it is linked through Kazakhstan.

In the Soviet times, the regions' hydropower and irrigation farming operated as a single integrated system, managed from a single centre in Uzbekistan. The system made it possible to balance seasonal fluctuations in demand for electricity and water for irrigation with fluctuations in water reserves in mountain rivers. In winter, Kyrgyzstan and Tajikistan accumulated water in reservoirs and received electricity and fuel (coal and natural gas) from Kazakhstan, Turkmenistan and Uzbekistan. During the summer, Kyrgyzstan and Tajikistan supplied the downstream Uzbekistan and Kazakhstan with hydropower and water for irrigation. After the fall of the Soviet Union, the system gradually fell apart and ceased to function in a centralised and co-ordinated manner, leading to shortages of electricity and water for irrigation.

Conditions for regional co-operation have recently improved. Since 2017, Uzbekistan, a major consumer of water of the region's transboundary rivers, has softened its position on constructing the Roghun HPP in Tajikistan and the Kambarata HPP in Kyrgyzstan, has taken practical measures to restore parallel operation with the energy system of Tajikistan, and has also initiated the restoration of the functioning of CAPS. It is expected that the participation of Tajikistan and Turkmenistan in CAPS will reduce the risks of electricity shortages in the predicted dry periods in the region.

Power system operations in Central Asia are co-ordinated and monitored by the regional Coordinating Dispatch Center (CDC) Energia, located in Tashkent. Established in 2007,

CDC Energia is an international, non-state, non-commercial organisation operating under the jurisdiction of the Republic of Uzbekistan. It operates cross-border transmission lines; maintains reliable parallel operations within CAPS; co-ordinates international power flows, planning, supervision of regional emergency automation and relay protection systems; and administers inter-system frequency control and electricity transit services.

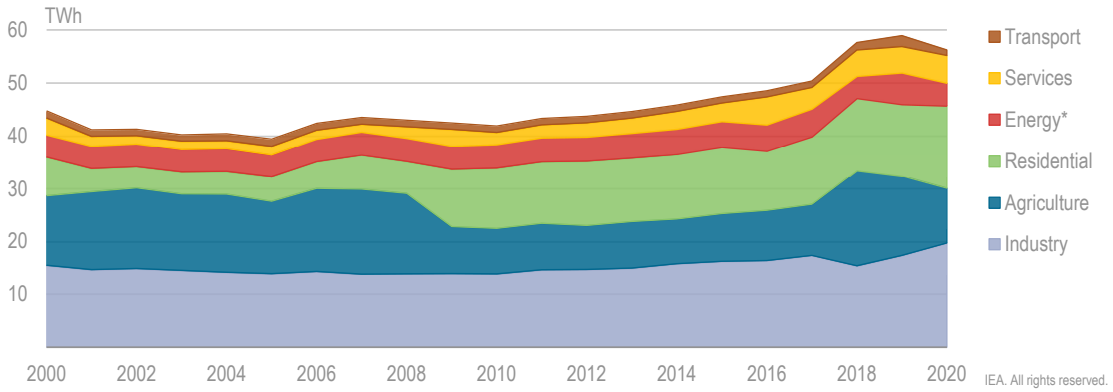
Recent investments in hydropower and cross-border trading capacity have enhanced electricity trade between Uzbekistan and Tajikistan. The demand patterns in Uzbekistan are complementary to Tajikistan's seasonal generation profile of summer surpluses and winter shortages, and the average cost of electricity generation (mainly from gas) in Uzbekistan (almost USD 50 per megawatt-hour [MWh]) is substantially higher than the marginal cost of generation (from hydro) in Tajikistan (average estimated at USD 6/MWh) (IEA, 2021). Uzbekistan imported 1.1 TWh of electricity from Tajikistan in 2021. In June 2022, the two countries signed a memorandum of understanding for future electricity supply from Tajikistan's Roghun HPP (Eurasianet, 2022).

Demand

Electricity consumption in 2020 was 56 TWh, over 30% more than in 2010. Industry was the largest consumer, at 35% of the total, up 42% since 2010. Iron and steel manufacturing consumes around half of the sectoral total, followed by chemicals and petrochemicals. The residential sector accounted for 28% of consumption (up 36% since 2010), followed by agriculture (18%), where electricity is mostly used by irrigation pumps.

The transport sector consumed only around 2%. However, It is likely to grow in response to the government's promotion of electric vehicles. The remainder was consumed by commercial and public services (9%) and the energy sector itself (8%).

Figure 5.6 Electricity consumption by sector, 2000-2020



Electricity demand declined in 2020 for the first time in more than a decade, but is set to return to continuous growth to 2030.

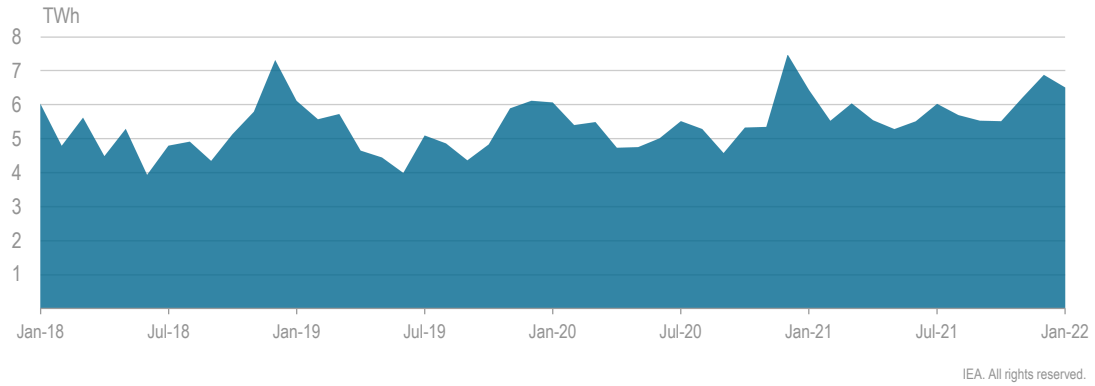
* Includes own use in electricity and heat generation and unspecified consumption in energy industries.

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

Electricity generation is linked with domestic demand. During peak load periods, up to 93% of TPP capacity is in use, which is why power consumption restrictions are introduced in

this period. Monthly demand peaks at about 7 TWh in December, driven by heating, while in summer, it peaks at about 6 TWh in July, driven by cooling. In 2019, maximum load during peak hours was 10.4 GW in winter and 9.4 GW in summer,

Figure 5.7 Uzbekistan's monthly electricity generation, January 2018-January 2022



Electricity generation has typically peaked in winter, but growing air-conditioning demand is increasing the summer peak.

Sources: UzStat, Industrial production of the Republic of Uzbekistan (monthly reports).

Key government institutions

The MoE, established on 1 February 2019, has many tasks, including the preparation and implementation of energy policies, plans and programmes in the power energy, renewable energy, and oil and gas industries in co-ordination with its affiliated institutions: Uzenergoinspektsiya (supervision in electricity sector), Uzneftegasinspektsiya (supervision in gas and oil sectors), the Agency for Development of the Nuclear Industry – Uzatom, and the Non-Commercial Organisation for Implementation of Production Share Agreements. The MoE centrally manages the technological process of electricity production, distribution and consumption through its Thermal Power Plants, National Electricity Grid of Uzbekistan and Regional Electricity Grids JSCs. The ministry participates in developing public-private partnerships and improving the tariff policy to help create electricity market competition.

The Ministry of Finance leads the work of the Interdepartmental Tariff Commission, established in 2018, which determines electricity tariffs. The ministry is also responsible for general control over financial stability of the state sectors.

The Ministry of Investment and Foreign Trade implements the state investment policy including FDI in the energy sector and co-operation with international financial institutions (IFIs) and foreign governmental financial organisations, as well devising and co-ordinating state policies on foreign trade and international economic co-operation.

The Cabinet of Ministers approves the rules for electricity and gas use as well as monitors investment programmes in the energy industry.

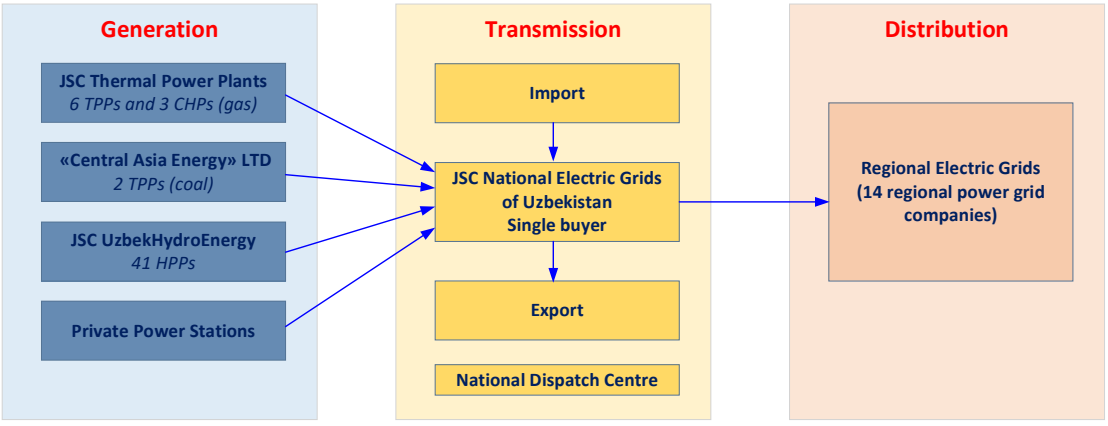
Electricity sector structure

The legal and economic structure of the electricity industry in Uzbekistan has always been relatively simple. Until 2019, electricity supply was a monopoly of the state-owned Uzbekenergo. The company was responsible for generation, transmission, distribution, dispatching and retail, operating through its branches in every region of the country. Since launching the sector reform in 2019, the government has been seeking to increase competition in this sector. The presidential decree providing for the unbundling, partial privatisation and the attraction of foreign investment to the power industry was signed on 27 March 2019. According to it, JSC Uzbekenergo ceased to exist and established JSCs replaced the holding company.

The main laws guiding the sector are relatively old and focus on ensuring the reliability of electricity supply:

- Law of the Republic of Uzbekistan ZRU-225 dated 30 September 2009. "On the electric power industry".
- "Rules for the technical operation of power plants and networks of the Republic of Uzbekistan" (Registered by the Ministry of Justice of the Republic of Uzbekistan on 10 September 2004. Registration No. 1405).

Figure 5.8 Uzbekistan electricity sector structure



Analysis by the World Bank, the ADB and the EBRD shows that to meet the rapidly growing demand for electricity and attract financing without the use of state guarantees for the development of the electricity sector, it is necessary to reform and move to a competitive market model.

Transmission and distribution

Transmission networks are state-owned through the system operator National Electricity Grid of Uzbekistan JSC. They are not subject to privatisation and external operation or management. The National Dispatch Centre of the National Electricity Grid of Uzbekistan JSC provides centralised operational dispatch of all power plants as well as the transmission and distribution networks.

The National Electricity Grid of Uzbekistan JSC transmits electricity from power plants to the distribution and marketing enterprises of the Regional Electricity Grids JSC via 35 kV to 500 kV main networks, in total 9 800 km of power lines.

Regional Electricity Grids JSC encompasses 16 enterprises, including 14 within territorial (regional) power networks, which operate distribution grids and oversee new construction and reconstruction as well as grid maintenance.

Distribution networks are 0.4 kV to 110 kV and include 29 000 km of power lines at 35 kV to 110 kV and 224 000 km of power lines at 0.4 kV to 10 kV. They also include around 75 000 transformer stations with a total capacity of 13 933 megavolt amperes (MVA).

Most components of the electricity networks have been in service for more than 30 years, including 66% of the transmission and 62% of the distribution networks, 74% of substations, and more than 50% of transformer stations. This is one of the reasons for the relatively high network losses, which amounted to 15.5% in 2020 (transmission losses 2.7%, distribution losses 12.8%).

The Electricity Supply Security Concept for 2020-2030 targets connecting all transmission networks into a single 500 kV grid by 2025. Meeting this goal requires:

- Connecting new generating assets and improving the reliability of electricity supply in the north-west to support, among other things, new industrial facilities in the Republic of Karakalpakstan and the Navoi region.
- Satisfying the growing electricity demand in Tashkent city and the Tashkent region through the construction of 500/220/110 kV substations with two 501 MVA automatic transformers and a 46 km 500 kV line.
- Improving the reliability in the southern power region as well as improving cross-border trade and interoperation with neighbouring countries' electricity systems through the construction of 500/500/220 kV substations in Surkhandarya region, with two 501 MVA (each), and build a 200 km 500 kV line from Surkhon-500 substation to Puli-Khumri substation in Afghanistan; 63 km 500 kV line from Guzar substation to Regar substation in Tajikistan.

Modernisation of existing and construction of new distribution networks is based on plans to:

- Add 110/35/10 kV substations through construction of new substations and upgrading existing 35/10 kV substations to a higher voltage.
- Construct 10 kV, 35 kV and 110 kV transmission lines through installation of underground cables or use of self-supporting insulated wires within cities and other population centres.
- Upgrade 35 kV and 110 kV substations to closed-type construction within cities and large population centres.
- Apply on a wide scale 35/0.4 kV step-down transformers within cities and large population centres.
- Phase out 6 kV voltage power systems and transition to 10 kV and 35 kV systems.
- Replace 0.4 kV to 10 kV overhead test lead wires with self-supporting insulated wires with reduction of the length of 0.4 kV lines.

The projects to modernise Uzbekistan's electricity transmission rely on financial and technical assistance from IFIs. They are carried out within the context of the Central Asia Regional Economic Cooperation (CAREC) programme, of which Uzbekistan is a key

member. For example, the World Bank is co-funding a project to modernise and upgrade 22 high-priority substations in the Tashkent City and 10 additional regions of the country, reducing technical losses, and operational and maintenance costs (CAREC, 2016). Recently, the World Bank approved the Electricity Sector Transformation and Resilient Transmission Project to construct a 500 kV transmission substation and associated transmission lines in 11 regions of Uzbekistan. The project will also introduce modern digital and telecommunication technologies, and solutions to improve monitoring, control, and operation of the transmission system (World Bank, 2021).

The ADB is working with Uzbekistan to improve transmission network reliability in the north-west regions of Karakalpakstan and Khorezm. The project is building a more than 360 km of 220 kV transmission line, as well as upgrading and expanding three key substations (ADB, 2021).

Tariffs and subsidies

The Interdepartmental Tariff Commission under the Cabinet of Ministers, established in 2018 and whose working body is led by the Ministry of Finance, determines electricity tariffs. The government plans to deregulate the customer prices of electricity as part of the sector reform. The MEDPR published in May 2022 a draft resolution for new electricity tariffs which proposes a transition to a wholesale market from 2026 (Uzbekistan MEDPR, 2022).

At the end of September 2021, Uzbekistan had more than 7.5 million electricity consumers, including 367 000 companies and 7.2 million residential consumers (Regional Electricity Grids JSC, 2021). The tariffs for commercial consumers partly covered the costs of, i.e. cross-subsidised, residential consumers.

Tariffs for generation, distribution and transmission of electricity as of April 2022 are approved on the basis of the decree “On measures to further improve the tariff policy in the electric power industry” (Uzbekistan, CoM 2019a) using the “cost-plus” approach.

The tariff system includes regulated tariffs and free (non-regulated) tariffs. Regulated rates include:

- Tariffs for electricity and heat from power plants.
- Mark-up for distribution and sales of electricity, applied by distribution organisations.
- Electricity tariffs for various consumers groups.

Free (non-regulated) electricity tariffs include tariffs for electricity purchased and sold under international agreements, including transit through national networks.

This tariff methodology does not incentivise regulated companies to optimise costs and improve efficiency. The tariff for end consumers is formed by summing up the weighted average costs for the production, transmission, distribution and supply of electricity.

Tariffs are formed for four groups of consumers defined in the Rules for the Use of Electric Energy. For large industrial consumers, they can be differentiated for three time periods of the day. The government sets the tariffs and has not changed them since July 2019 (Uzbekistan, CoM 2019a).

Table 5.2 Electricity tariffs in Uzbekistan, June 2022

Group of consumers	Tariffs per kWh (with VAT)
1. Commercial consumers (with a connected capacity of 750 kilovolt amperes [kVA] and above)	UZS 450 (USD 0.042) Half peak 9:00-17:00 UZS 450 (USD 0.042) Peak 6:00-9:00 and 17:00-22:00 UZS 675 (USD 0.062) Night 22:00-6:00 UZS 300 (USD 0.028)
2. Other commercial consumers (with a connected capacity less 750 kVA)	UZS 450 (USD 0.042)
3. Residential consumers	UZS 295 (USD 0.027) Residential consumers with electric stoves UZS 147.5 (USD 0.014)
4. Tariff for group I and II consumers, for heating, hot water supply and cooking	UZS 50 (USD 0.0046)

Source: Uzbekistan, CoM, 2019a.

Electricity supply contracts oblige all consumers to make 100% prepayments for electricity. According to the Regional Electricity Grids JSC, all consumers are equipped with smart electricity meters, which enables billing according to the time of day and automatically limiting consumers.

The advance payment goes to a special account from where it is automatically divided among the generating companies and transmission and distribution operators according to the approved tariffs and their percentage in the final price.

In line with the Electricity Supply Security Concept for 2020-2030, differentiated tariffs for electricity for residential consumers based on time of day, working days and holidays are planned to begin in 2022, and feed-in tariffs for surplus electricity generated by own renewable sources in 2023.

Subsidies are considered as social support for vulnerable and low-income consumers, and the social policy in the electricity sector is implemented by keeping tariffs below economically justified levels for all households. According to the MoE, after two increases during 2018-2019, the coverage of costs by current tariffs went up from 70% to 92%.

The government's draft resolution for new electricity tariffs from May 2022 suggests a transition to a system of the "social norm tariff", i.e. a reduced tariff rate up to a certain maximum volume of consumption above which a free-market price applies. In practice, all tariffs would increase and help bring the sector closer to financial viability.

Around 80% of households consume on average up to 200 kWh of electricity per month. However, they account for only 31% (5.7 TWh) of the total annual household electricity consumption. To rationalise the price support for households, the government carried out household consumption surveys in the Tashkent and Namangan regions and the city of Tashkent and based on them, suggests limiting the social norm tariff to 250 kWh/month (Uzbekistan, MEDPR, 2022).

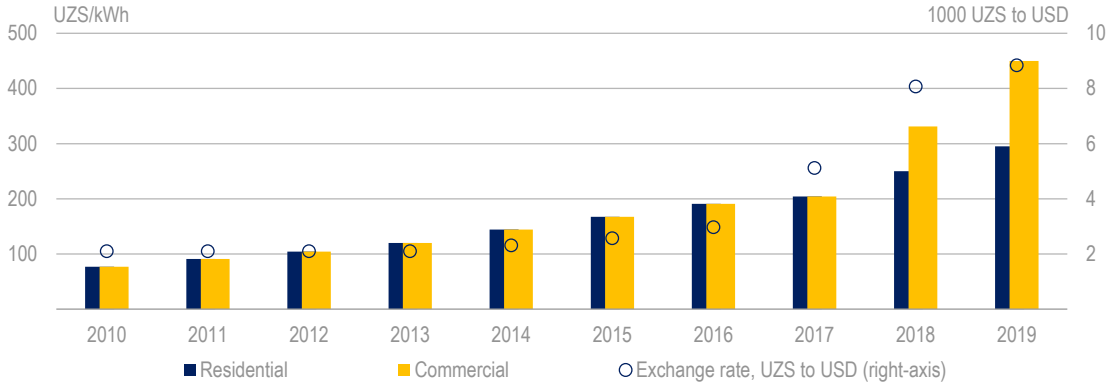
Table 5.3 presents the suggested electricity tariffs from 1 July 2022. From 1 April 2023, the tariff for the group *other legal entities* would be raised to UZS 700/kWh.

Table 5.3 Suggested electricity tariffs in Uzbekistan from July 2022

Group of consumers	Tariffs per kWh (with VAT)
Residential consumers for consumption up to 250 kWh/month	UZS 325 (USD 0.03)
Residential consumers for consumption above 250 kWh/month	UZS 650 (USD 0.06)
Navoi MMC, Almalyk MMC and budget organisations	UZS 800 (USD 0.074)
Other legal entities	UZS 600 (USD 0.055)

Source: Uzbekistan, MEDPR (2022).

Figure 5.9 Electricity tariffs in 2010-2019



Uzbekistan's electricity prices were long among the lowest in the world, but the government is gradually raising them ahead of a planned deregulation.

Note: Electricity prices were at the 2019 level in June 2022.
Source: Energy Charter Secretariat, (2022), In-Depth Review of the Energy Efficiency Policy of the Republic of Uzbekistan, https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Uzbekistan_2022__en.pdf.

The government is gradually increasing electricity tariffs. However, the tariffs are still lower than in neighbouring countries and very low in an international comparison, remaining inadequate to recover operation and maintenance costs and increasing financing for new projects.

The MoE stresses that, just as in the gas sector, as electricity prices are not market-based and as fixed assets are obsolete, financial conditions of power companies deteriorate. This is particularly true of the National Electricity Grid JSC which had a UZS 2.1 trillion (around USD 200 million) loss in 2021. The losses of state-owned enterprises and their financial obligations will eventually lead to a direct and indirect increase in the state budget expenditures (Uzbekistan, MoE, 2022a).

Market reform

Electricity market reform is the government's second major energy policy focus area, alongside the oil and gas market reform. The reform design is consistent with Uzbekistan's Electricity Supply Security Concept for 2020-2030, adopted in April 2020. The concept's main goal is to meet the growing electricity demand, the deficit of which was estimated at 9.4% in 2012-2019. The concept expects the following results by 2030:

- phasing out obsolete power plants and increasing generation capacity to 29.2 GW
- commissioning new low-carbon capacity: 5 GW of solar PV, 3 GW of wind power and 2.4 GW of nuclear power
- increasing electricity generation to 120.8 TWh, almost twice the 2020 level
- reducing natural gas consumption for power generation from 16.5 bcm to 12.1 bcm and increasing coal consumption from 4.1 Mt to 8.5 Mt
- privatising most generation capacity, except for HPPs and nuclear power plants
- reducing transmission grid losses from 2.72% to 2.35% and distribution grid losses from 12.47% to 6.5% of the input to the grid
- reaching the goals of improving environmental conditions and increasing energy efficiency.

Electricity market reform aims to:

- Ensure meeting the fast-growing demand for electricity.
- Improve the quality of power supply services to consumers.
- Attract adequate financing without state guarantees.
- Mitigate the need for electricity tariff increases by reducing the cost of electricity generation.

The reform plan has been developed in consultation with experts provided by the World Bank, the ADB and the EBRD. Experts agreed that for the transition to a competitive market model to succeed, the following preconditions need to be met, regardless of the electricity market model and the duration of the transition period:

- Adopt a new electricity law. The law should define the status and functions of government supervision, regulation and policy-making bodies in the electricity sector, as well as responsibilities and functions of each entity involved in the generation, distribution, transmission, purchase and sale of electricity.
- Develop an electricity network code to regulate network connection and use.
- Introduce legally binding non-discriminatory wholesale and retail electricity market rules.
- Prevent power outages during the transition to a competitive wholesale electricity market by promoting domestic production and imports.

In June 2022, the draft electricity law and the draft electricity grid code were being considered by government entities. Also, a presidential decree on further electricity market reforms had been drafted. Finally, measures to increase electricity supply to avoid outages had been taken, including building wind and solar power capacity (see Chapter 6, Renewable energy) and gas-fired capacity and ensuring electricity imports.

Uzbekistan has already taken steps to reform its electricity sector. The former vertically integrated state-owned monopoly Uzbekenergo has been divided into three separate companies in charge of generation, transmission and distribution, respectively. The generators (Thermal Power Plants JSC and Uzbekhydroenergo) sell the electricity to the single buyer/transmission system operator National Electricity Grid of Uzbekistan JSC at prices that are expected to cover all generating costs. The National Electricity Grid of Uzbekistan JSC sells the electricity to Regional Electricity Grids JSC, which in turn supplies the electricity to all consumers, including large industrial users, at fixed rates.

The plan for further electricity market reform consists of three stages. At the first stage:

- The legal basis for the transition to a competitive market will be created.
- An independent market regulator will be established.
- Market rules will be approved.
- Market operator will be established.
- Transmission system operation and Single Buyer functions will be split up as separate companies.
- Tariffs for electricity sold by the generators to JSC Single Buyer are regulated by the Market Regulator.
- The tariff for the transmission of electricity for National Electricity Grid JSC (TSO) is set by the Market Regulator as a single tariff throughout the republic.
- Tariffs for electricity sold by JSC Single Buyer to Regional Electricity Grids JSC are regulated by the Market Regulator.
- Tariffs for electricity sold to consumers by Regional Electricity Grids JSC are regulated by the Market Regulator.
- An online market platform will be created.

At the second stage:

- The functions of selling electricity to consumers will gradually be transferred to private operators.
- Tariffs for electricity sold by the generator to the JSC Single Buyer are regulated by the Market Regulator.
- The tariff for the transmission of electricity for National Electricity Grid JSC (TSO) is set by the Market Regulator.
- Tariffs for electricity sold by the JSC Single Buyer to private operators are regulated by the Market Regulator.
- Tariffs for electricity sold to consumers by Regional Electricity Grids JSC are regulated by the Market Regulator.
- Tariff for the distribution of electricity by Regional Electricity Grids JSC (national distribution company) is set by the Market Regulator as a single tariff throughout the country.
- Tariffs for the sale of electricity to consumers are regulated by the Market Regulator, provided that private operators set their own surcharges on the costs of generating, transmitting and distributing electricity.
- All generators sell electricity only through an online platform (power exchange) based on the existing monthly contracts.
- Large industrial enterprises buy electricity through the power exchange from producers at market prices.
- Private operators buy electricity from generators through the power exchange at market prices.

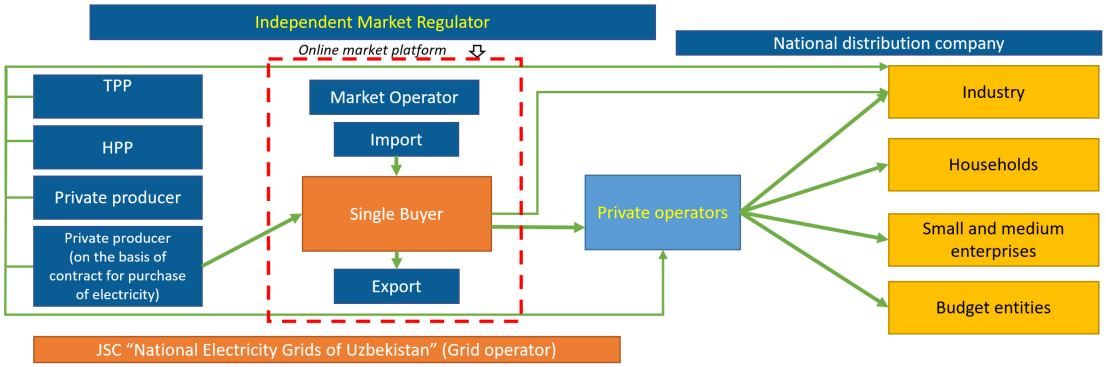
At the third stage:

- Daily trades on electricity at power exchange will be launched.
- All generators sell electricity only through an online platform power exchange) based on existing daily contracts.

- The functions of selling electricity to consumers will be fully transferred to private operators, and a competitive retail market will be formed.
- The tariff for transmission for National Electricity Grid JSC (TSO) is regulated by the Market Regulator as a single tariff across the country.
- The tariff for distribution by Regional Electricity Grids JSC (distribution company) is set by the Market Regulator as a single tariff across the country.
- Electricity produced by private producers is purchased by JSC Single Buyer at the tariffs specified in the agreement.
- JSC Single Buyer sells electricity to private operators at traded tariffs.
- Tariffs for the sale of electricity to consumers are regulated by the Market Regulator, provided that private operators set their own surcharges on the costs of generating, transmitting and distributing electricity.
- Large industrial enterprises buy electricity from generators through the power exchange at traded tariffs.
- Private retailers buy electricity from generators through the power exchange at traded tariffs.
- Compliance with the market laws by participants is ensured by the Market Regulator.

The reform should lead to a new competitive market structure shown in Figure 5.10. Competitive retail markets have emerged and consumers buy electricity at their own discretion from various private operators.

Figure 5.10 The structure of the electricity market after reforms



Source: Ministry of Energy, 2022.

Electricity security

Security of electricity supply has remained a concern in Uzbekistan and in the broader Central Asian region, with several large blackouts affecting more than one country in recent years. The region's population and economic growth are increasing electricity demand year after year, and the power system infrastructure, which largely dates from the Soviet era, urgently needs to be expanded and modernised.

Uzbekistan's electricity supply security relies on use of the country's abundant domestic natural gas as the default energy source and on the establishment of adequate national generation capacity. At the beginning of 2021, Uzbekistan had 15.9 GW of generating

capacity, 13.9 GW of which was thermal and around 11 GW of which was available. During peak load periods, up to 93% of TPP capacity is in use, which is why power consumption restrictions are introduced in this period.

Demand for electricity in Uzbekistan is growing and significantly depends on the time of year: pronounced consumption peaks occur during the colder months, but also in summer for cooling. Gas-fired power plants, which make up the bulk of electricity generation, face gas supply restrictions, especially in winter. The planned increase in solar and wind power generation will alleviate the gas reliance, but their variability is an electricity security question that needs to be addressed.

At the same time, more network infrastructure needs to be modernised, and the country continues to lack governance and operational security protocols and measures for electricity security. Out-of-date technologies and equipment have decreased the reliability and efficiency of energy system operations, while the lack of electricity supply reliability has been one of the government's main energy security concerns. The January 2022 countrywide and cross-border blackout particularly revealed the urgent need to improve the electricity system's ability to maintain reliability and respond to emergencies (Box 5.2). Wide blackouts also occurred in November 2020 and January 2021.

The MoE stresses that the high level of obsolescence of distribution networks and transformers leads to power outages and deterioration in power quality indicators. Loading of transformers exceeds the established technical standard of 80% in 101 cities and districts. In particular, the load level of transformers in the Tashkent region is 95%, in the Andijan region 92%, in Tashkent city 90%, and in the Namangan region 84% (Uzbekistan MoE, 2022b).

To overcome the emerging challenges, a comprehensive system of energy security must be put in place that should include clear targets and indicators of progress covering fuel safety, resource adequacy, operational safety and power system management.

The quality of network service is regulated by the Interstate Standard GOST 32144-2013 "Electric energy. Electromagnetic compatibility of technical equipment. Power quality limits in the public power supply systems". Uzbekistan has mandatory legislation to monitor the quality of electricity supplies based on the international system average interruption duration index (SAIDI) and the system average interruption frequency index (SAIFI) (Uzbekistan, President, 2019a), but data are not available.

Box 5.2 Central Asian Power System blackout in January 2022

On 25 January 2022, a massive power outage left Kyrgyzstan and Uzbekistan without power and also cut 40% of the population of southern Kazakhstan off the grid. Heating and water supply stopped in cities, the Tashkent subway and airport were closed, and Uzbekneftegaz JSC suspended operations of refineries, gas processing plants and production at 64 fields. It took Kyrgyzstan a day and Uzbekistan four days to restore electricity supply to consumers.

A special commission of CDC Energia (Box 5.1) identified as the cause of the accident a shutdown in the electricity system of Uzbekistan. On 22 January 2022, at 11:59 am, a short circuit occurred on the linear disconnector of the 500 kV overhead power line

connecting the Syrdarya TPP and the 500 kV Tashkent substation. The operation of the differential protections of the first and second 500 kV busbar systems caused a significant decrease in generation at the Syrdarya TPP, multiple outages in the network adjacent to the power plant, and a power surge of 2 100 MW on Kazakhstan's 500 kV North-East-South connection.

Source: KEGOC (2022), The cause of the 25 January 2022 accident in the power grids of Kazakhstan, Uzbekistan and Kyrgyzstan has been revealed, https://www.kegoc.kz/en/press-center/press-releases/155880/.

Globally, the concept of electricity security is being broadened to also respond to three emerging challenges: the clean energy transition, cybersecurity and climate change. Technology developments and climate change mitigation efforts are spurring an electricity supply transition from centralised, vertically integrated systems of relatively few large, dispatchable TPPs to more diversified capacity types and sizes that include variable solar and wind power in particular. While cybersecurity concerns are linked with the increasing digitalisation of electricity supply systems, the need for demand-side measures is also rising as connected devices, electric vehicles and behind-the-meter distributed energy resources become more prevalent. Finally, mounting evidence indicates that electricity system infrastructure needs to be better adapted to climate change impacts such as heatwaves and droughts, and the associated reductions in water availability (IEA, 2020). These emerging electricity concerns are likely to become increasingly relevant for Uzbekistan.

District heating

The district heating (DH) sector of Uzbekistan is mainly represented by state-owned and communal enterprises operating in the capital, Tashkent, and large cities of Uzbekistan. The Ministry of Housing and Communal Services (MCSO), established in 2017, is the central state body in the field of DH, and it works to improve energy efficiency, quality and availability of heating services.

The MCSO manages most DH systems, while local governments manage a few heat supply organisations. There are currently 33 heat suppliers in the DH systems in Uzbekistan, of which 12 are located in the city of Tashkent. The most developed DH system is located in Tashkent with 54.4% of the total length of heat supply networks and where about 40% of heat was produced in 2020 (ECS, 2022).

According to the MHKO, the total length of DH networks is 4 250 km, which is decreasing every year (during 2010-2019, the total length of heating networks decreased by 16.8%, or from 4 965 km to 4 250 km). Heating networks mainly consist of steel pipes with mineral wool insulation and about 30% of heating networks have insufficient thermal insulation or no thermal insulation at all. In 2019, 1 440 km (34%) of 4 250 km of heating networks and 495 (76%) of 648 central heating networks were in operation. Thus, 66% of heating networks and 24% of combined heat and power (CHP) plants require replacement or reconstruction.

The vast majority of DH systems in Uzbekistan were built during the Soviet Union and are obsolete. Initially, DH systems were designed as open systems when the heat carrier is transferred directly, without a heat exchanger, which led to accelerated deterioration of

heat transport and distribution networks and inefficient use of energy. These inherited weaknesses have been exacerbated by the significant underinvestment in maintenance, rehabilitation and modernisation of DH assets over the past two decades, resulting in a significant deterioration in the quality of DH services.

In 2019, there were 45 082 multi-apartment buildings in the country, of which 43% are connected to DH and hot water systems, and 57% to individual heating systems. In some apartment buildings disconnected from the centralised heat supply, the population uses gas and electric heating appliances.

Most of the heating networks are run by municipal organisations of local executive committees (*khokimiyats*) that deal with all types of public services such as housing maintenance, water supply, sewerage, waste disposal, etc.

The 2017 Programme for Development of the Heat Supply System for the period 2018-2022 (2017 Resolution of the President No. 2912) is carried out with financial support from the World Bank (Uzbekistan President, 2017). According to the programme, the main priorities in the DH sector are to ensure:

- Performance of a unified policy.
- Effective implementation of programmes on development, modernisation, and upgrade of service infrastructure.
- Introduction of energy-efficient technologies.
- Organisation of modern automated metering systems.
- Replacement of heat-boiler equipment, trunk distribution networks and in-house heating systems.
- Transition from open to closed systems with installation of building-level individual heat substations.
- Introduction of decentralised heating options to make space heating more cost-effective.

By the decree of the president, it is necessary to implement a number of measures that allow the transformation of the heat supply sector to begin at the system level by realisation projects:

- with the participation of the World Bank, "Reconstruction of the district heating system and energy efficiency in the cities of Andijan, Chirchik, Bukhara, Samarkand and Tashkent" with a total cost of USD 220.7 million, providing for the modernisation and reconstruction of central boiler houses, heating systems and networks, restoration of intra-house and intra-apartment heat supply systems with the transition to a closed heat supply system
- jointly with the Japan International Cooperation Agency of the project "Modernisation and reconstruction of the central boiler houses of the cities of Bukhara, Ferghana, Kuvasay, Nukus and Urgench" with an estimated cost of USD 780.4 million, which provides for the reconstruction of heating equipment of heat sources with the introduction of co-generation gas turbine technology, as well as the replacement of main and distribution thermal networks.

Tariffs for thermal energy in Uzbekistan are formed as follows:

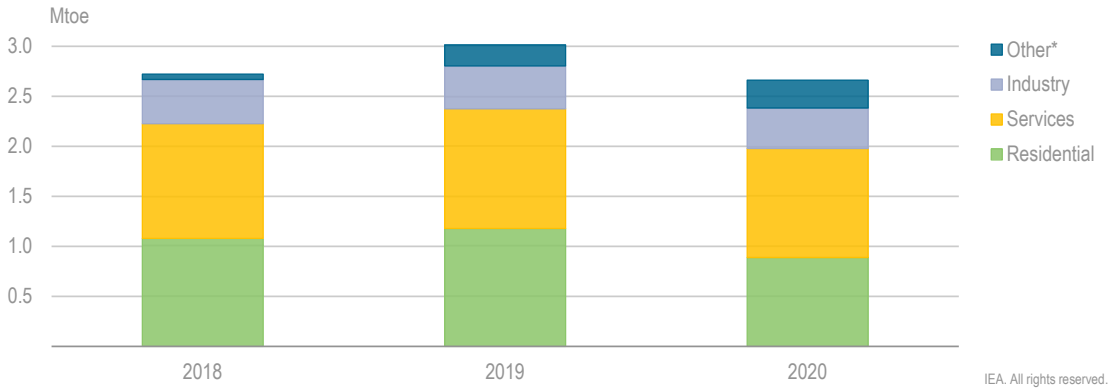
- Starting from the 2020-2021 heating season, heat tariffs are set based on 1 square metre (m^2) of heated area per day of the heating season.

- From 1 January 2020, heat supply tariffs include costs for the development and modernisation of DH systems.
- The subsidies of USD 33 million related to the use of reduced tariffs for heat and hot water for the population will be covered from the republican and local budgets.

Also, the decree of the president envisages that a gradual transition to full cost recovery will be based on the reduction of production costs and losses in the DH system. The implementation roadmap provides for the adoption of the Law on Thermal Energy (Uzbekistan, MHCS 2020). and the implementation of comprehensive measures in the DH infrastructure, including the introduction of co-generation and the installation of heat meters. As part of the decree, a list of comprehensive measures was included, including the development of a strategy for the development of a heat supply system, an energy audit, the creation of a single billing operator, and the introduction of an automatic control and accounting system.

The DH system of Tashkent adopted separate Presidential Decree No. PP-4543 (Uzbekistan, President 2019c), which includes targets to reduce heat losses and reduce electricity consumption at pumping stations for 2020-2022. It is expected that by 2022 the collection rate will increase from 64% to 81% and above; the coverage rate for the installation of heat meters will be 45% (per building) and 30% for hot water meters (per apartment).

Figure 5.11 District heat consumption, 2018-2020



District heat is primarily used for space heating, where it competes against gas boilers and electric heating.

* Includes agriculture and unspecified consumption.
Source: UzStat, Pilot fuel and energy balance of the Republic of Uzbekistan (various editions).

Assessment

Uzbekistan's electricity demand is set to rise in the years and decades ahead. Although the entire population has access to affordable electricity, the current supply level of around 2 000 kWh per capita per year is relatively low – and expanding electrification will only increase demand. To maximise the benefits of electricity for the population, investments are required in new and more efficient generating capacity and electricity grids. The country needs a more dynamic electricity sector and could model transformation on international best practices that demonstrate how to develop competitive electricity

wholesale and retail markets. The IEA welcomes the government's determination to reform the electricity system. The government has already taken steps to gradually transition from a state-dominated vertically integrated system to a more dynamic, efficient and environmentally sustainable one. The challenge now is to follow on the reform path and deliver the metamorphosis.

Market reform

The need for electricity reform is recognised in Uzbekistan's Green Economy Transition Strategy for 2019-2030 (from 2019) and the Security of Electricity Supply Concept in 2020-2030 (from 2020). Several proposals have been drafted, including the draft law on electricity, the electricity network code and the presidential decree on further electricity market reforms. A well-structured three-stage reform plan exists for a transition to a competitive electricity market, but its implementation is largely yet to begin.

The IEA urges the government to adopt the pending legislation and to implement ambitious electricity market reforms for the benefit of the country and its economy. International experience suggests that reform approaches should be shaped by a country's specific political and economic context, be tailored to achieve desired policy outcomes, and offer multiple institutional pathways to achieve the desired outcomes.

The government should first focus on governance issues and financial viability. Tariffs and subsidies should be revised to enable full cost recovery, and to encourage investment in power sector development. Reforms of this kind should help reduce operating costs and improve generation, transmission and distribution efficiency. It is therefore encouraging to see the government's May 2022 proposals for revised tariffs. When implemented, they are an important step in the direction of full cost recovery and a manifestation of rational economic policy.

Specific policy objectives should also be set for a secure, efficient and clean electricity system. Although Uzbekistan has large gas resources to generate electricity, it is also in the enviable position of having excellent solar and wind power potential. Technology costs for solar and wind have declined dramatically over the past decade, making it more inviting for the country to tap into their potential and save more natural gas for petrochemicals production, for example. To enable the energy sector to allocate resources more efficiently, the IEA urges the government to also reform and gradually abolish subsidies for natural gas in electricity generation.

At the same time, diversifying electricity generation to include more renewable energy would help limit CO_2 emissions and air pollution. In this context, the IEA welcomes the government's plans to raise the share of renewable energy in total electricity supply from 10% in 2020 to 25% in 2030. The government also has plans to build the country's first nuclear power units, with Rosatom, but it is not clear whether and when this project will be realised. Recent international experience has shown a real risk of major delays and cost overruns in large nuclear power projects.

The IEA supports the government's plan to open up electricity generation to competition, and create wholesale and retail markets. This is best done gradually. The first steps should be to remove entry barriers for new participants and to transition towards unsubsidised cost-based economic dispatch of power plants to increase efficiency. This should be quite feasible, since almost all generating capacity is owned by two state-owned companies.

To increase competition, the government should consider privatising some of the state-owned generating assets. Emphasis should be on privatisation as a potential means to increase competition and operational efficiency rather than as an end in itself, and full privatisation will probably not be necessary to achieve the desired goals. For example, in many European countries, the state remains the majority shareholder in electricity generators that operate in competitive wholesale markets. New entrants could also be entirely private or based on public-private partnerships, as long as market entry barriers are removed. An important point to consider relates to increasing the share of variable solar and wind power capacity. If the government plans to attract more investment through long-term PPAs, a mechanism should be designed to integrate such PPAs into the future wholesale market.

Gains from more efficient generation and grid operations would limit the need to raise end-user prices, and in any case social policy measures could be targeted to vulnerable customers. Network operations need to be remunerated sufficiently to enable the TSO and DSO to modernise, maintain and, in light of rising electricity demand and solar and wind power generation, expand the networks.

A major necessary step in Uzbekistan's electricity market reform will be the establishment of a Market Regulator. This should be done without delay. The more independent the regulator, the better for the market participants and, eventually, the customers. It will be essential to grant the future Market Regulator the legal right to take binding decisions and issue recommendations.

Efficiency would be further increased by differentiating consumer tariffs by time of use to encourage electricity consumption when it is less expensive, and thus help businesses increase their competitiveness. Time-of-use tariffs are standard practice in many countries, as they provide an incentive for demand-response applications, smooth the daily load curve, decrease peak loads and reduce the need for additional capacity. Dynamic end-user pricing could also encourage utilities to innovate, for example in terms of demand response measures.

Electricity security

Having an uninterrupted supply of electricity is critical for a modern society. In their efforts to ensure electricity security, many IEA member countries have found it useful to set up a comprehensive framework, supported by laws, regulations, policies and measures that address generation, transmission, distribution and supply challenges. The IEA urges Uzbekistan to consider a similar framework approach.

An electricity security framework should include clear targets covering fuel security, resource adequacy, operational security and governance. It should also include indicators to measure progress. Uzbekistan's fuel/energy source security appears not always sound, as the demand for the country's natural gas resources, the main energy source for electricity, is growing fast in other sectors, too. The plans to diversify into solar and wind power generation, possibly also nuclear power, appear well-founded also from the security of supply angle. Several solar and wind power projects are under way. Efforts to modernise and expand Uzbekistan's electricity networks need to be intensified and supported with measures to ensure the financial capacity of the network owners to maintain the networks.

Operational security aspects also need improvement. While the gas-fired power plants that dominate generation are being modernised, the major blackouts in recent years have

demonstrated that improvements are needed in several areas: system operations, emergency protocols, resilience, co-ordination and communications, and situational awareness. Another key area to strengthen is governance, including legislation, institutions and regulation.

New risks for electricity security are emerging in three areas: the clean energy transition (i.e. grid integration of variable renewable electricity), cybersecurity and climate change (IEA, 2020). The IEA recommends a five-point approach to respond to them:

1. Put the right framework and institutions in place: clearly establish responsibilities, incentives and rules.

2. Identify risks: undertake regular system-wide risk analyses.

3. Manage and mitigate risk: improve preparedness across the electricity supply chain.

4. Monitor progress: track, record and share experiences.

5. Respond and recover: cope with outages or attacks and benefit from the lessons learned.

Energy policy makers should raise awareness of these three risk areas and engage with all government agencies as well as stakeholders to improve understanding and decide how to avoid and deal with complications.

To help prevent electricity security emergencies, the government should carry out emergency response exercises, as they have proven effective in boosting preparedness and response capability in other countries. In addition, the government could devise probabilistic simulations to assess how various system elements contribute to operational security related to solar and wind generation variability, generator and transmission line outages, cross-border connection availability, system reserve margins, load variability, and demand response.

Efficient system operations

A decade of electricity sector changes lies ahead for Uzbekistan as it implements market reforms and takes action to more than double the share of renewable electricity in total electricity supply by 2030. While the government should assess electricity infrastructure requirements and prepare long-term network development plans, it also needs to ensure that it has enough people with the expertise necessary to accomplish this transformation.

Of increasing concern is the grid integration of variable solar and wind power, which will require greater electricity system flexibility. While gas-fired capacity will continue to provide flexibility, the government should also prepare a general plan for ancillary services, including storage and demand response. An ancillary services market should be developed to allow energy-intensive enterprises (such as manufacturing iron and steel and chemicals and petrochemicals) to participate in a demand response system.

As cross-border trade can also be a source of flexibility and improved economic efficiency, the IEA is glad to note that Uzbekistan has strengthened its cross-border connections. The country intends to significantly increase its electricity exports in the coming years, while trade with hydropower-rich Tajikistan would allow seasonal imports of hydropower generation.

Uzbekistan is modernising its transmission and distribution infrastructure and has succeeded in reducing network losses in recent years. Modernising network infrastructure offers the opportunity to upgrade it and make it smarter: installing smart meters, digital substations, sensor control and operational systems would help raise efficiency. It would also accommodate higher shares of solar and wind power and prompt the adoption of cybersecurity protection measures. Furthermore, it would encourage the use of demand-side response systems to reduce curtailments of solar and wind power generation and support electric vehicle integration.

Finally, Uzbekistan needs a network code to ensure electricity system stability and reliability. A code can facilitate the successful integration of increasing shares of solar and wind power, and would also help ensure equipment quality and standardisation. The IEA therefore urges the authorities to adopt the network code that has been drafted as soon as possible.

District heating

The government of Uzbekistan faces the difficult task of rehabilitating the DH systems in order to use energy resources efficiently, especially in large cities. The legacy of the Soviet Union in the form of open DH, as well as old and non-functioning DH systems, requires significant costs for modernisation and reconstruction. Establishing a sustainable financing system that fully covers costs and allows investments to be attracted from the DH sector should be a goal when developing legislation for DH. With a high potential for the introduction of RES, it is necessary to consider the joint use of fossil and renewable energy sources for DH.

Recommendations

The government of Uzbekistan should:

Electricity

- Continue the planned gradual liberalisation of the electricity sector and reduction of government's role to create competitive wholesale and retail electricity markets.
- Appoint an independent energy regulator in technical and tariff policy to balance the interests of all stakeholders.
- Consider introducing time-of-use and level-of-voltage tariffs for all industrial consumers, and to encourage them to implement energy efficiency measures.
- Introduce long-term electricity security targets for generation, transmission, distribution and supply.
- Introduce digitalisation and automation technologies to modernise the electricity infrastructure at all levels.
- Conduct detailed technical, economic and environmental studies to support the decision on whether to build nuclear power capacity.

- Explore and unlock opportunities for cross-border electricity trade, including exchange for peaking and balancing capacity from neighbouring hydro-rich countries and for developing dedicated joint projects in these countries. Strengthen the co-operation with the Central Asia unified power grid.

District heat

- Adopt a draft law on heat supply to balance the interests of heat producers, suppliers and final consumers.
- Promote wider application of high-efficiency co-generation and efficient DHC systems.
- Modernise the DH systems to diversify heat sources and to add flexibility, for example, by integrating them with heat storage, heat pumps and/or solar thermal facilities.
- Introduce the energy service company (ESCO) concept for refurbishing the heating systems in the apartment buildings.

References

ADB (Asian Development Bank) (2021), Uzbekistan Power Transmission Improvement Project, https://www.adb.org/projects/47296-001/main#:~:text=The%20Asian%20Development%20Bank%20is,upgrading%20and%20expanding%20three%20substations.

ADB (2019), ADB supports Uzbekistan in expanding the use of hydropower resources, https://www.adb.org/ru/news/adb-supports-uzbekistan-harnessing-indigenous-hydropower-resources.

CAREC (Central Asia Regional Economic Cooperation), (2016), CAREC in Uzbekistan, https://www.carecprogram.org/?page_id=12.

ECS (Energy Charter Secretariat) (2022), In-Depth Review of the Energy Efficiency Policy of the Republic of Uzbekistan, https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Uzbekistan_2022__en.pdf.

Eurasianet (2022), Uzbekistan commits to buying power from Tajikistan's Roghun plant (3 June, 2022), https://eurasianet.org/uzbekistan-commits-to-buying-power-from-tajikistans-roghun-plant.

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

IEA (2021), *Cross-Border Electricity Trading for Tajikistan: A Roadmap*, https://www.iea.org/reports/cross-border-electricity-trading-for-tajikistan-a-roadmap.

IEA (2020), *Power Systems in Transition*, www.iea.org/reports/power-systems-intransition.

NEGU (National Electricity Grid of Uzbekistan JSC) (2022), Main performance indicators, https://www.uzbekistonmet.uz/en/lists/view/69).

Regional Electricity Grids JSC (2021), General information, https://www.het.uz/ru/pages/view/general_info.

Uzbekistan, CoM (Cabinet of Ministers) (2019a), Resolution of the Cabinet of Ministers of the Republic of Uzbekistan, dated 13 April 2019, No. 310, https://lex.uz/ru/docs/4289882.

Uzbekistan, CoM (2019b), On additional measures to improve the rating of the Republic of Uzbekistan in the annual report of the World Bank and the International Finance Corporation "Doing Business", dated 9 July 2019, No. 567, https://lex.uz/ru/docs/4412703.

Uzbekistan, CoM (2019c), Resolution of the Cabinet of Ministers of the Republic of Uzbekistan, dated 30 Julyl 2019, No. 633, https://lex.uz/ru/docs/4453961.

Uzbekistan, MoE (Ministry of Energy) (2022a), Three new thermal power plants have been commissioned in three regions of the country in three months, https://minenergy.uz/en/news/view/1865.

Uzbekistan, MoE (2022b), Информация по вопросам реформирования энергетического сектора Министерства экономического развития и сокращения бедности, финансов и энергетики [Information on reforming the energy sector by the Ministry of economic development and poverty reduction], https://minenergy.uz/ru/news/view/1952.

Uzbekistan, MEDPR (Ministry of Economic Development and Poverty Reduction) (2022), Explanatory note to the draft Resolution of the Cabinet of Ministers of the Republic of

Uzbekistan "On the use of prices for fuel and energy resources", https://mineconomy.uz/ru/news/view/4616

Uzbekistan, MHCS (Ministry of Housing and Communal Services) (2020), Draft of Law on Thermal Energy, https://regulation.gov.uz/ru/d/23635

Uzbekistan, President (2021), On additional measures for the further development of hydropower, PP-44, dated 10 December 2021, https://lex.uz/ru/docs/5769775

Uzbekistan, President (2019a), On the strategy for further development and reforming of the power industry of the Republic of Uzbekistan, PP-4249, dated 27 March, http://lex.uz/ru/pdfs/4257085

Uzbekistan, President (2019b), On additional measures to improvement of the heat supply system and financial recovery of heat supply enterprises, PP-4542, dated 2 December 2019, https://lex.uz/ru/docs/4624861

Uzbekistan, President (2019c), On measures to further improve the heat supply system of the city of Tashkent, PP-4543, dated 2 December 2019, https://lex.uz/ru/docs/4624846.

Uzbekistan, President, (2017), Programme for the development of the heat supply system for the period 2018-2022, PP-2912, dated 20 April 2017, https://lex.uz/ru/docs/3177186.

World Bank (2021), Uzbekistan to reform and green its electricity sector, with World Bank support, 25 June 2021, https://www.worldbank.org/en/news/press-release/2021/06/25/uzbekistan-to-reform-and-green-its-electricity-sector-with-world-bank-support.

6. Renewable energy

Key data

(2020 provisional)

Total renewable energy supply: 0.43 Mtoe (0.9% of TES): virtually all hydropower; bioenergy*, wind and solar contribution negligible

Total renewable electricity supply: 5.0 TWh (7.5% of electricity generation): virtually all hydropower; wind and solar <0.01 TWh

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

* Bioenergy (e.g. solid biofuels) consumption in the residential sector has not been quantified, therefore the quantity is likely underestimated.

Overview

While natural gas continues to dominate Uzbekistan's TES and electricity supply, renewable energy (RE) provided around 8% of electricity generation in 2020, practically all from hydropower. Biomass is a major fuel for heating and cooking in rural areas, but exact data on its contribution are not available.

Uzbekistan has only recently started to develop its vast solar and wind energy. The government plan is to install 12 GW of variable renewable energy (VRE) capacity and 1.5 GW of hydropower capacity by 2030. With high solar irradiation and wind speeds over the vast undeveloped territories, Uzbekistan has enormous potential for solar and wind power development that may have regional geopolitical importance and trigger cross-border co-operation to make Central Asia a hub for renewable electricity and green hydrogen production. The current intensive gradual development of renewable power might be prioritised and streamlined in view of this strategic opportunity.

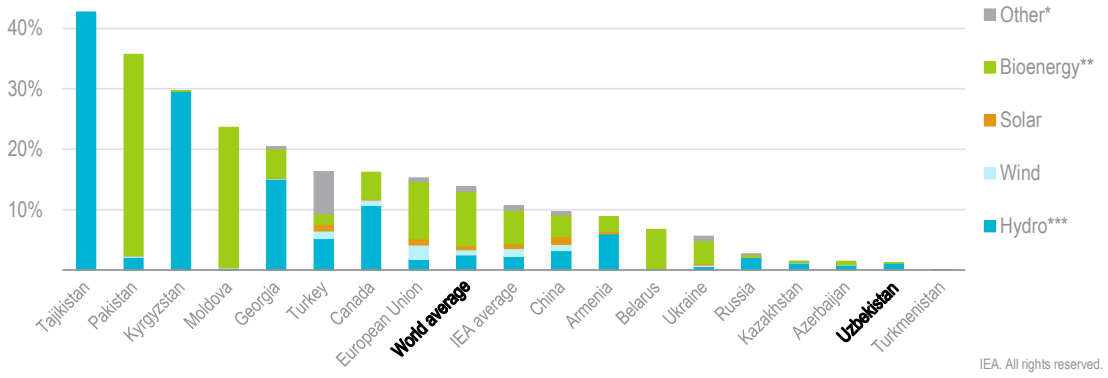
Renewable energy, in combination with flexible power generation, can help to reduce the fossil fuel dependence of the electricity sector of Uzbekistan. Electricity grids remain a limiting factor for development of renewable energy. The balancing capacity and network extension to less populated areas with high solar and wind potential deserve a holistic consideration in view of strategic long-term development which could turn Uzbekistan into a regional hub for renewable energy. HPPs cannot be fully engaged in balancing the variable renewables as their regimes are primarily governed by irrigation needs. Therefore, new technological solutions and potential for exchange with neighbouring countries should be explored.

Renewable energy supply

Supply

The share of renewable energy in Uzbekistan's total energy supply (TES) has been stable – but low – since the 1990s. The portion of RE in electricity generation fluctuates, given it reflects the country's changing hydrological conditions and, in consequence, its hydropower output. During 2000-2019 the share ranged from 8% to 19% of total generation, and averaged around 12%. The dominance of hydropower in renewable energy leads to similarities in the patterns of renewable energy in TES and in TFC.

Figure 6.1 Renewable energy share of TES in selected countries, 2019



Uzbekistan's gas-dominated energy supply has had one of the lowest shares of renewable energy globally, but the country has major plans to diversify away from gas and increase renewable energy capacity by 2030.

* Includes geothermal, primary heat, and wave and ocean energy.
** Includes solid, liquid and gaseous biofuels and renewable waste.
*** Excludes pumped storage.
Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Bioenergy

Bioenergy supply consists mostly of primary solid biofuels with some contribution from biogas. Although limited data are available regarding traditional uses of biomass for heating, several kinds of biomass are traditionally used primarily in households in rural areas, including cotton stalks for cooking and livestock and poultry waste for fuel (IEA, 2020).

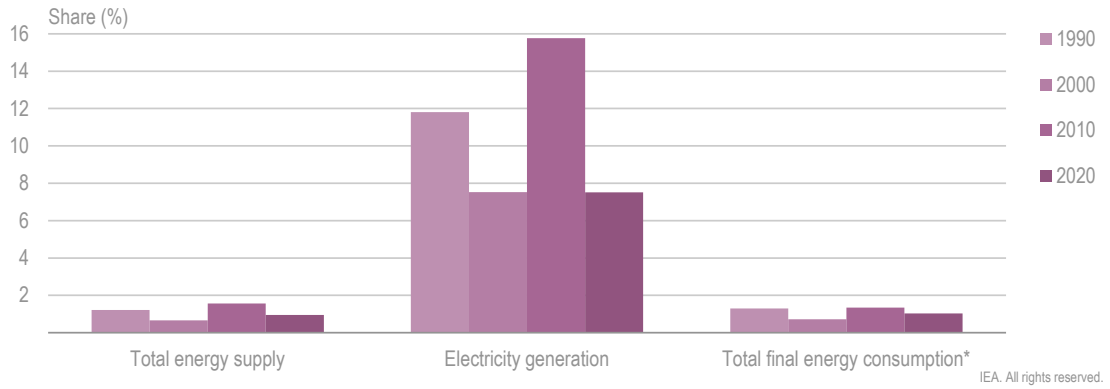
There are no official statistics for bioenergy consumption in Uzbekistan. In other words, the current level of bioenergy (e.g. fuelwood) use in the country is yet to be assessed. This requires surveying the energy consumption in households, particularly in rural areas. Conducting such a survey would allow quantifying what types of biomass (fuelwood, cotton husks) are used, for what purpose (e.g. heating, cooking) and with what technologies (e.g. the type of stove).

Nevertheless, it is known that Uzbekistan's cotton fields and irrigation canals (surrounded by reeds) provide a vast amount of biomass. Cotton stems are traded on a market and stored for winter use. The efficiency and safety of their use needs to be studied to avoid poor indoor air quality and related health risks.

Renewable electricity

Total installed generation capacity of Uzbekistan's power system was 12.9 GW in 2019, of which 1.85 GW, or 14.3%, is from 42 HPPs of large and medium size. These HPPs generated 6.5 TWh, or 10.2% of the total, in 2019.

Figure 6.2 Renewable energy shares in Uzbekistan's energy system, 1990-2020

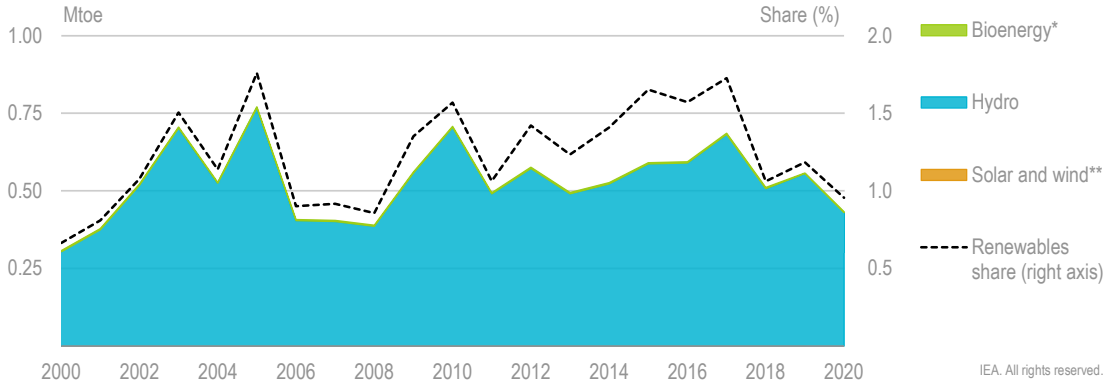


The deployment of wind, solar and hydropower will increase the renewable shares in electricity generation and final energy consumption.

* Includes direct use in TFC and indirect use through electricity and heat consumption.
Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Hydropower accounted virtually for all of the total renewable energy supply in 2020, with minuscule contributions from bioenergy (fuelwood) and solar and wind electricity. The government has indicated a strong desire to develop the wind power and solar PV sector to 2030. The current utilisation of bioenergy has not been assessed and may be grossly underestimated.

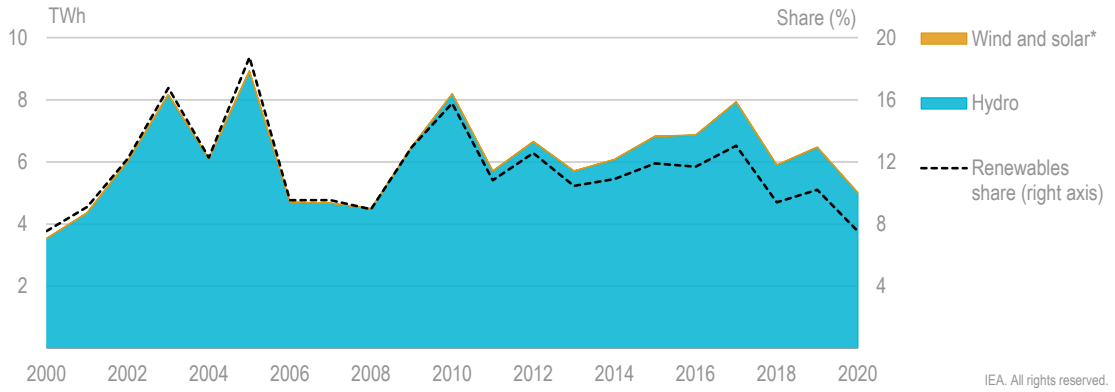
Figure 6.3 Renewable energy in Uzbekistan's TES, 2000-2020



Hydropower dominates Uzbekistan's relatively low renewable energy supply, but more detailed bioenergy data may change the picture.

* Data not available from national sources, hence estimated based on Food and Agriculture Organization sources; although consumption is likely underestimated.
** Negligible quantities, not visible at this scale.
Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Figure 6.4 Renewable energy in Uzbekistan's electricity generation, 2000-2020



The government plans to raise renewable energy to at least 25% of electricity supply by 2030, focusing on solar, wind and hydro capacity additions.

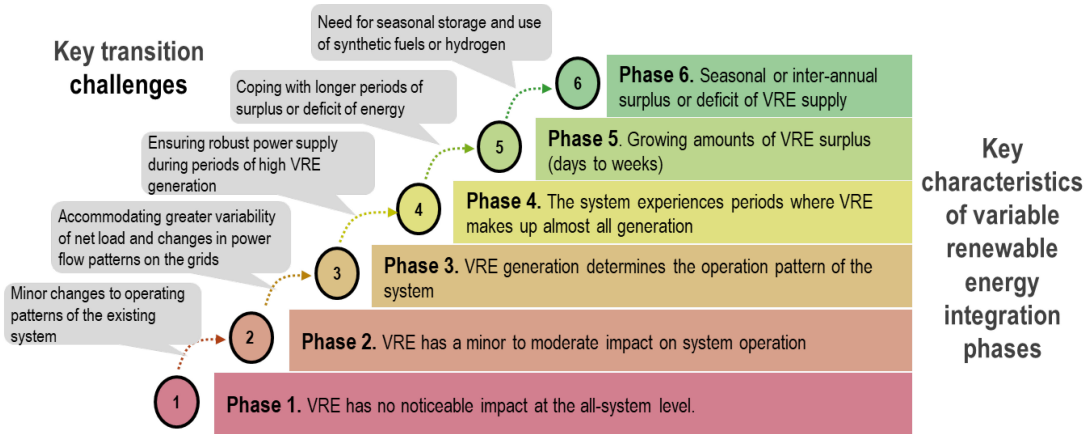
* Not visible at this scale.
Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

According to the MoE, the power generation capacity includes 42 HPPs, 12 of which are large ones with a total installed capacity of 1.68 GW (86.8% of the total HPP capacity); 29 small HPPs with a total capacity of 0.26 GW (13.2%) and 2 micro HPPs with a total capacity 0.5 MW. Ten plants (1.4 GW in total) are reservoir plants while the rest are run-of-river. Half of the capacities are new and/or modernised.

The Uzbek power system is already facing the problem of balancing the supply and demand due to the absence of sufficient flexible generation. It currently uses coal and gas power plants for balancing, while hydropower plants cannot fully contribute to system flexibility as their operation is predominantly governed by irrigation needs. The expected rapid increase in the share of VRE generation may add to the difficulties and require both strengthening the grid and adding the flexible generation sources. New combined-cycle gas turbine (CCGT), gas turbine and reciprocal engine gas-fired plants are being built partly to address this problem.

The IEA has identified six phases of VRE integration, each with its own challenges and responses. With its rapidly growing solar and wind generation, Uzbekistan is moving from Phase 1, in which VRE integration does not have much additional impact on system balancing, to Phase 2 and further Phase 3 when solar and wind power will have a sizeable impact and require significant balancing capacities.

Figure 6.5 Phases of variable renewable energy integration and their key characteristics



As new solar and wind capacity moves Uzbekistan towards Phase 2 and 3, more system flexibility will be required.

Source: Adapted from IEA (2018), *World Energy Outlook 2018*, https://www.iea.org/reports/world-energy-outlook-2018.

Renewable energy potential

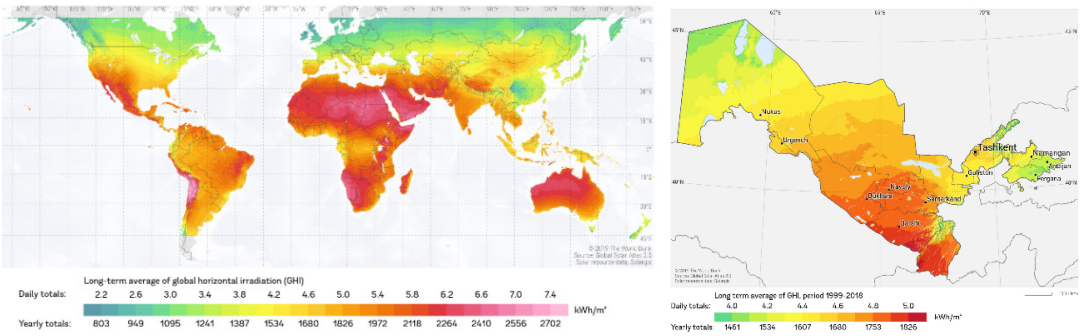
Thanks to its size, geography and climate, Uzbekistan enjoys enormous solar and wind power potential, especially in sparsely populated areas not currently used for agriculture. In addition, more opportunities also exist for hydropower, including pumped storage, but climate change and water use primarily for irrigation may limit this potential. Large-scale agriculture and animal farming offer large although unexplored bioenergy potential. Proper utilisation of the country's renewable energy potential will be required to reach the target of 25% of RE in electricity supply by 2030, compared with the current 10.2%.[3] This potential could help Uzbekistan become a renewable energy exporter in the region. Achieving these goals requires formulating a holistic and ambitious strategic vision and co-ordinated energetic actions including attraction of large investment.

Solar energy

The country benefits from high values of solar irradiation. Global horizontal irradiance (GHI) including both direct and diffuse radiation[4] in Uzbekistan is estimated at 4.52 kWh/m^2 in the median value, which is higher than Spain (4.46 kWh/m^2/day) and Italy (4.07 kWh/m^2/day).

[3] Due to insufficient information on biomass use, these numbers refer to only hydropower and potentially wind and solar power.
[4] The direct radiation refers to the sunlight coming directly from the sun's disk, while the diffuse radiation refers to light coming from various directions.

Figure 6.6 Solar energy potential in Uzbekistan



Global horizontal irradiation, world (left) and Uzbekistan (right).

These maps, adapted by the IEA, were obtained from the "Global Solar Atlas 2.0", a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info. The Works are licensed under the Creative Commons 4.0 Attribution International license, CC BY 4.0.
Sources: World Bank (2022a) Global Solar Atlas: World, https://globalsolaratlas.info/download/world; and Global Solar Atlas: Uzbekistan, https://globalsolaratlas.info/download/uzbekistan.

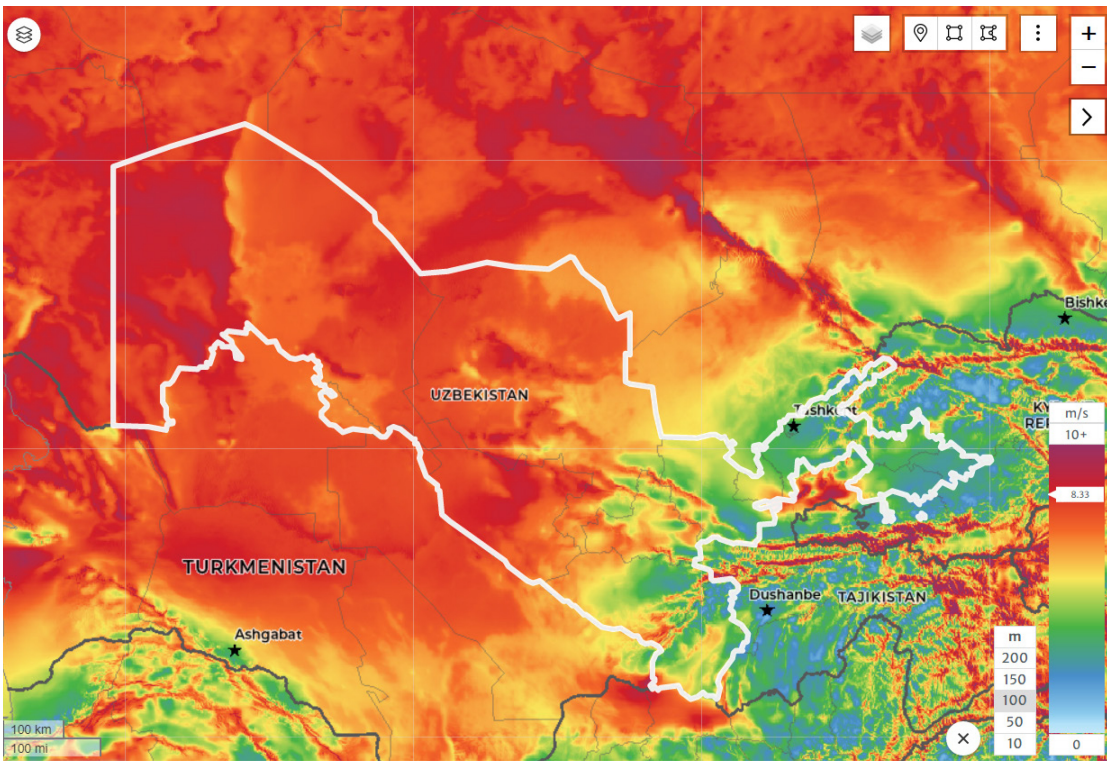
Direct normal irradiance (DNI) relevant for concentrating solar power (CSP) and solar thermal technologies is 4.44 kWh/m^2/day in the median value (ranging from 3.03 kWh/m^2 to 5.27 kWh/m^2 per day). As a comparison, Spain and the United States, the major markets for CSP globally, show slightly higher median DNI figures (5.34 kWh/m^2/day in Spain and 4.76 kWh/m^2/day in the United States), but these are on par with values observed in the southern regions of Uzbekistan.

Estimates for Uzbekistan's technical potential for solar power generation are several times higher than the country's entire primary energy supply, ranging from 177 Mtoe (Dungboyet, Karimov and Karshiyeva, 2020) to 265 Mtoe (ISEI, 2019). Uzbekistan is sunny and has large territories suitable for solar power plants. The best resources are in the south of the country, in the Bukhara, Samarkand and Qarshi regions. Economic potential depends also on the capacity of Uzbekistan's electricity system to integrate the variable solar power output and to export its renewable energy in the form of electricity or potentially green hydrogen.

Wind energy

Wind energy potential of Uzbekistan remains to be well defined. Official sources quote 360 Mtoe of gross technical potential (Uzbekistan MoE PPT, 2022). Publicly available data (World Bank, 2020b) indicate that the best wind potential is concentrated in the western part of Uzbekistan, in particular in the underdeveloped areas of Karakalpakstan to the west and south of the drying Aral Sea. The average wind speeds of above 8 m per second and the high capacity factors of wind farms are comparable with offshore wind farms. Even a partial utilisation of the wind potential could generate far more than the current and projected needs of Uzbekistan and may have a regional importance.

Figure 6.7 Wind energy potential in Uzbekistan – average annual wind speed distribution



This map, adapted by the IEA, was obtained from the "Global Solar Atlas 2.0", a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info. The Works are licensed under the Creative Commons 4.0 Attribution International license, CC BY 4.0.
Source: World Bank (2020b), Global Wind Atlas: Uzbekistan, https://globalwindatlas.info/area/Uzbekistan.

Biomass and geothermal

Uzbekistan has the potential to use cotton stems, residues from other crop production sectors, industrial, domestic and livestock waste and reeds to produce heat and potentially electricity. The annual gross energy potential of cotton plant stalks is estimated to be 2.3 Mtoe. Reeds, another vegetative resource, grow spontaneously along the banks of canals and water bodies in volumes of 10 Mt to 12 Mt per year. More than 10 million cattle and 15 million sheep and goats generate more than 100 mcm of organic waste per year (Uzhydromet, 2016). The resources of forest logging, however, are insignificant, since only 3.2% of Uzbekistan land area is forested and cutting trees is officially not permitted (IEA, 2022b; Uzhydromet, 2016). The cotton residues are widely used by population for heating and cooking and the potential for increased efficiency of this use needs to be explored.

Other forms of renewable energy, such as low enthalpy geothermal, could provide up to 1 GW of capacity, considerably less than the potential of biomass estimated in the range of 15 GW to 17 GW (mostly for agricultural and domestic use) (MoE, 2021).

Hydropower

Uzbekistan depends strongly on inflow from neighbouring upstream countries for its water resources. The main use of the water resources is for agriculture, and energy management is subordinated to irrigation needs. Climate change may affect water runoff and availability. Technical hydropower potential is estimated at 2 Mtoe (23.3 TWh) per year (IEA, 2020).

Additional studies to identify the effects of climate change on hydropower resources as well as hydrology measurements on smaller water courses could help better plan large and small hydropower facilities.

Executive institutions

The energy sector in Uzbekistan is under a large-scale transition to a market-based system and attraction of private investment for sector development. Key institutions and stakeholders related to renewable energy policy include:

The MoE, established in February 2019, develops and implements energy policies, plans and programmes, and leads the formulation and implementation of renewable energy policy in Uzbekistan. The MoE is also responsible for the regulation and supervision of the production, transmission, distribution and consumption of energy resources including electricity. Moreover, the MoE plays a role in developing public-private partnerships and improving the tariff policy.

The Ministry of Finance plays the central role in consumer price regulation including tariff setting for electricity and general control over financial stability of the state entities. It serves as an executive body for the Inter-agency Commission on Tariff Setting.

The Ministry of Investment and Foreign Trade is responsible for implementing the state investment policy including FDI in the energy sector, and co-operating with IFIs and foreign governmental financial organisations, as well as devising and co-ordinating state policies on foreign trade and international economic co-operation. The ministry is a lead state entity conducting the tenders for new renewable generation capacity and signing the respective agreements as part of public-private partnership policy.

The Ministry of Economic Development and Poverty Reduction is in charge of analysing and forecasting macroeconomic development indicators based on projected market development mechanisms and strategies in various subsectors of industry, including energy.

The Cabinet of Ministers approves the rules for electricity and gas use as well as monitors investment programmes in the energy industry.

Targets, strategies and plans

The government is aiming for higher volumes and shares of renewable energy in the coming years. To ensure energy security and promote renewable energy use, it has adopted a wide range of strategies and action plans.

In its NDC ratified in 2018, Uzbekistan committed to decreasing specific emissions of GHGs per unit of GDP by 10% by 2030 (compared with 2010). In its updated NDC in 2021, it raised the commitment to reduce GHG emissions per unit of GDP by 35% from 2010 to 2030. A key part of meeting this pledge is to increase the solar and wind generation capacity to 8 GW by 2026 and 12 GW by 2030 (7 GW solar, 5 GW wind), an increase from the 8 GW target set out in 2019 (see Chapter 8, Energy and Climate).

The Presidential Decree 4422/2019 on Accelerated Measures to Improve Energy Efficiency of Economic and Social Sectors, the Introduction of Energy-Saving Technologies and the Development of Renewable Energy Sources sets a target for renewable electricity to supply at least 25% of all electricity by 2030. It aims to stimulate widespread further use of energy efficiency measures, solar collectors, biogas facilities and heat pumps, including through subsidies to individuals and companies developing solar PV facilities.

The Green Economy Transition Strategy for 2019-2030 (Presidential Decree No. 4477 of 4 October 2019) encompasses a wide range of objectives for several sectors of the economy. For the energy sector, the objectives include:

- Raising the renewable energy share in the power mix to more than 25% by 2030 (as compared to 7.5% in 2020).
- Using solar collectors for water heating; increasing automation for transmission and distribution.
- Modernising and reconfiguring the power grid to increase power system stability.
- Equipping power consumption systems with smart meters.

In response to the Strategy for 2019-2030, the government developed the **Concept of Electricity Supply of the Republic of Uzbekistan for 2020-2030** (MoE, 2020). The concept note identified a larger renewable energy capacity as a main objective to improve electricity supply and set a target to increase generating capacity from 12.9 GW in 2019 to 29.3 GW by 2030 and electricity generation from 63.6 TWh in 2019 to 120.8 TWh by 2030. The variable renewables generation capacity was expected to grow by 8 GW to 2030, a sum of 5 GW of solar power and 3 GW of wind power capacity. In addition, hydropower capacity was expected to grow by 1.7 GW.

The concept includes a programme to install around 150 000 solar PV plants (capacity of 2 kilowatts [kW] to 3 kW) and water heaters (200 litres on average) in 2-2.5% of households in 2021-2025. This capacity is expected to generate around 0.8 TWh of energy per year.

The Presidential Decree of 10 December 2021, PP-44, "On additional measures for hydropower development", mandates the increase of hydropower capacity to 3 416 MW by 2030 through modernising generation facilities and constructing new ones. It includes a list of such projects and, to attract private investment in small hydro, offers state support, guaranteed grid connection and guaranteed power purchase. The purchase tariffs are set at the levels of 70% of second-tier consumer tariff (USD 0.04/kWh) for run-of-river, 100% for reservoir and 150% for pumped storage facilities of Uzbekhydroenergo. Small HPPs (less than 5 MW), solar PV and biogas autoproducer plants are entitled to feed-in tariffs for excess energy at the level of 80% of the same tariff. Twenty-three small and micro HPPs with a total capacity of 33.8 MW and output of 156.2 gigawatt-hours per year will be

offered to private developers in 2024-2030. In addition, legislation will be developed to support private investment in micro and small HPPs.

The electricity network development strategy in the Republic of Uzbekistan until 2025 was formulated in July 2019 to guide the construction of new and modernisation of existing transmission and distribution lines as well as substations up to 2025. Strengthening the electricity networks will be essential for deployment of more renewable electricity.

For the longer term, the *Roadmap to Carbon Neutral Electricity Sector in Uzbekistan by 2050* (MoE, 2021) provides insights on the policies, technologies and investments necessary to achieve a carbon-neutral power sector by 2050. It envisages 8 GW of VRE by 2030 and 97 GW by 2050. The roadmap is so far not reflected in the government's official targets (IEA, 2022b).

Legal and regulatory framework

The Law on the Use of Renewable Energy Sources (RES Law, 2019) adopted in May 2019, creates the basic framework for accelerated development of RES. It defines the responsibilities of public entities in supporting renewable energy and specifies the rules and support schemes for renewables power producers.

The law defines the MoE of the Republic of Uzbekistan as the authorised state body in the field of the use of renewable energy. The ministry is also tasked with keeping and updating the information on actual renewable energy production and potential for the purpose of policy making.

Under the RES Law, legal entities and individuals who install energy facilities are eligible for benefits and incentives, including the following tax incentives and exemptions:

- Renewable energy producers are exempt from property tax for renewable energy installations (above 100 kW) and land tax in the areas used by these installations for ten years after commissioning. They are also granted the right to create local distribution networks and conclude agreements with legal entities and individuals for the sale of energy (electricity, biogas).
- Producers of renewable energy equipment are exempt from all taxes for five years from the date of their state registration. Customers are exempt from property tax on off-grid renewable installations in residential buildings for three years. They are also exempt from the land tax.

The Law of Uzbekistan on Public-Private Partnerships of 10 May 2019 is directed towards attracting investors in large renewable energy projects. The law defines the goals of the government policy and responsibilities of public bodies for its implementation. The special public-private partnership agency under the Ministry of Finance is an authorised government body. The public-private partnership project partners can be selected through tenders or direct negotiations. Tenders can be one or two stage; the two-stage tender requires prequalification for the projects over USD 1 million. Project awards through direct negotiations are conducted in exceptional cases of: state security importance, exclusive rights of the private partner (intellectual rights and other), mandate by presidential decrees or government resolutions.

The law provides the subsidies and concessions to guarantee the minimum income of a private partner. The state support measures include: contributions in the form of assets, land and property needed for public-private partnership project implementation; funds from the budgetary system; budget loans, grants, credit lines and other financing instruments; safeguards and guarantees including compensation for the change of law; and tax incentives. The law has become a basis for construction of all new large-scale solar and wind projects.

In addition, the Cabinet of Ministers has adopted several regulations related to renewable energy, including the regulations:

- on measures to ensure metering the energy produced from renewable energy sources and installations
- on the rules for the placement of large solar PV plants
- on the rules of tendering auctions for lowering the starting price in the field of renewable energy sources
- rules for conducting the auctions and the rules on purchasing electricity from small renewable facilities as well as regulation on grid connection of generation entities, including renewable sources
- on connecting entities producing electricity, including from renewable energy sources, to the united electric power system.

Renewable electricity

The 2019 RES Law provides the right to producers of renewable electricity to connect to the unified power grid through consumer-owned centrally dispatchable substations or to connect to the grid on a competitive basis by nominating the marginal cost of electricity to be supplied to the grid.

The law does not provide for feed-in tariffs. Renewable electricity tariffs are determined on the basis of competitive bidding.

The grid owner is responsible for the costs of network modifications for the connection of renewable energy, while renewable energy producers are responsible for the costs up to the network connection point.

The construction of a local distribution network and the connection of renewable energy to it are carried out at the expense of the renewable energy producer. Electricity consumers are connected to local renewable electricity networks under bilateral contracts.

Renewable heat

The 2019 RES Law specifies biogas produced as biodegradable material of plant and animal waste and residues, or industrial and municipal waste. Producers of biogas and/or renewable heat for own needs do not need any permits. They may create local networks at own cost and to conclude agreements with legal entities and individuals for the sale of energy. They may not, however, connect renewable energy to existing gas distribution and transmission networks. Biogas consumers are connected to the local network of biogas on the basis of individual agreements. The same provisions apply to renewable heat producers and consumers.

To promote the use of local renewable energy solutions for solar heat in buildings, all new and refurbished buildings, except for individual houses, must have certified solar water heating installations for hot water supply, in accordance with the Decree on the Programme for the Development of the Heat Supply System for the Period 2018-2022. All state institutions also are set to be switched from the centralised hot water supply to solar water heating plants from 2022. Moreover, to stimulate solar heat use in individual houses, the government started in 2020 to provide subsidies for individuals to purchase solar water heaters.

Current and planned renewables projects and programmes

Uzbekhydroenergo JSC is a state-owned company that operates HPPs. The company was separated from Uzbekenergo JSC and established as a separate entity in May 2017. In total, it operates 37 HPPs with the installed capacity of 1 853 MW. The government plans to increase the capacity of hydropower plants to 3 416 MW for 2030.

The presidential decree on additional measures for further development of hydropower (PP-44, December 2021) lists 4 big (>30 MW), 10 medium (5 MW to 30 MW), and 9 small and micro (<5 MW) HPPs to be constructed and 12 existing plants to be upgraded by Uzbekhydroenergo by 2030 for a total of 1.5 GW of additional capacity. It also lists 22 small and micro HPPs (<5 MW) offered to the private sector.

To attract the foreign investment in large-scale solar PV projects, the government has implemented competitive bidding processes based on PPP law, with the help of the International Finance Corporation (IFC), ADB and EBRD.

Ten large-scale solar projects totalling 2 050 MW have been put out to tender mostly in the southern and south-western regions where GHI is higher than the national average, 1 300 MW of which were awarded as of August 2021, while the 100 MW project in the Navoi region started operation in August 2021. The prices achieved are considerably lower than world average for solar PV installations (see Table 6.1).

Table 6.1 Announced large-scale solar PV projects in Uzbekistan

Awarded year	Project location	Offered capacity (MW)	Awarded tariff (USD/MWh)	Supply period (years)	Awarded company
2020	Karmana district, Navoi region	100	26.79	25	Abu Dhabi Future Energy Company PJSC (Masdar)
2021	Samarkand region	100	n/a	25	Total Eren
2021	Nurata district, Navoi region	200	n/a	25	Phanes Group
2021	Samarkand region	220	17.91	25	Masdar
2021	Jizzakh region	220	18.23	25	Masdar
2021	Sherabad district, Surkhandarya region (Phase I)	457	18.045	25	Masdar

Source: IEA (2022b), *Solar Energy Policy in Uzbekistan: A Roadmap*.

In January 2022, an additional tender was announced for a 300 MW solar park in the Guzar district of Kashkadarya region. In June 2020, Masdar (United Arab Emirates) signed an agreement with the Ministry of Investments and Foreign Trade and JSC National Electric Grid to construct a 500 MW wind farm project. The Zarafshan Wind Farm in the Navoi region was the biggest planned project in Central Asia and will help avoid 1.1 Mt of CO_2 per year.

The Saudi developer ACWA Power signed an agreement for the 100 MW Nukus wind project in Karakalpakstan valued at USD 108 million for a tariff of USD 0.0257/kWh. It now continues the development of additional 1 000 MW of wind power capacity in Karakalpakstan. The wind measurements have started on seven sites.

Assessment

Uzbekistan has started to move rapidly to build significant renewable energy capacity. The government plan is to increase the share of RES to at least 25% of the country's electricity supply by 2030. This would help ensure energy security supply and meet the country's climate commitment to cut its GHG emissions per GDP by 35% by 2030.

Starting from only 4 MW of solar capacity at the end of 2020, the country now has more than 2 GW of solar and 1.5 GW of wind power projects under development. It is well on track to install 4 GW solar and 4 GW of wind power projects by 2026, and another 3 GW of solar and 1 GW of wind power for a total of 12 GW of VRE capacity by 2030, as defined in Uzbekistan's updated NDC under the Paris Agreement in 2021. Uzbekistan is also planning to upgrade 14 HPPs and develop 18 new hydro projects by 2030 for a total of 1.7 GW. Uzbekistan is moving to the forefront of Central Asian countries in deploying renewable energy. The IEA welcomes these developments and commends the government of Uzbekistan for its remarkable work on renewable energy.

Uzbekistan has started to use tenders to attract FDI in renewable electricity capacity. Preliminary agreements have been signed for up to 4 GW of solar and wind power capacity at internationally very competitive prices. Along with favourable solar and wind conditions, this reflects investor confidence. The government can further improve the investment climate with additional energy sector reforms, such as establishing an independent energy regulator and streamlining regulation.

Further development of renewable energy needs to be co-ordinated with overall energy sector development under a comprehensive strategic vision that takes into account all technical and economic opportunities and limitations a well as regional and global trends. Data and information as well as a well-trained professionals will be needed to ensure consistency across various energy and climate policies and to maximise efficiency and impact of renewables development. Some relevant factors are listed below.

Attracting investment in renewable energy

The plans to construct 12 GW of solar and wind power capacity and add 1.5 GW of hydropower capacity by 2030 are ambitious and demanding. However, as Uzbekistan has ample renewable energy potential, especially for solar and wind energy, even more could be built, provided there is a regulatory environment providing adequate remuneration, grid access, system integration and the removal of non-economic barriers for attraction of private investment. The number of signed agreements with private developers and the low PPA prices achieved at the auctions indicate a strong investor interest and efficient administration of the tendering process.

The development of solar and wind projects initiated under the public-private partnership law is based on state-guaranteed PPAs and hydropower developed mostly by state-owned Uzbekenergo. Moreover, the state also finances the construction of flexible TPPs for balancing the VRE on the grid. All of this may cause an excessive burden on the state budget in view of the high ambition of goals and possible increase of renewable energy development costs. Indeed, the deficit of raw materials and supply chain disruptions caused by the recent pandemic and geopolitical turbulence are raising the prices of renewable energy equipment and materials and may render the low auction-based prices achieved so far unsustainable, and even potentially affecting the contracted projects. Therefore, for the sustainability of renewable energy development and to save the budget already loaded by energy subsidies, mechanisms are needed to pass through the costs to consumers and create price signals for investors.

Uzbekistan currently does not have cost-based prices and a competitive electricity market to provide price signals for investors. Nor does it have an ancillary services market to provide adequate reserve and flexibility. These need to be gradually developed notably through establishment of an independent regulator and the cost-based tariffs and proper market mechanisms. Otherwise, private companies will be reluctant to enter the sector without specific government guarantees.

Fuel subsidy reform would offer numerous benefits for large and small-scale renewable energy development, help the country meet its CO_2 emissions reduction targets, and save gas for exports and for petrochemical production.

Utilising the vast renewable energy potential in the long term

The available public data indicate outstanding renewable energy potential in Uzbekistan. High annual wind speeds and solar irradiation available in Uzbekistan are notably spread over vast undeveloped territories of tens of thousands of square kilometres not used for agriculture or other economic activity. These areas provide the potential of green energy that goes much beyond the current and expected needs of Uzbekistan and may have regional and wider international importance. Rough estimates indicate that hundreds of terawatt-hours of green electricity and millions of tonnes of green hydrogen could be produced by developing combined solar and wind power capacity in these areas.

The feasibility of energy development in areas like western Karakalpakstan deserves closer consideration. As a first step, the industry standard measurements should be conducted to assess the wind and solar data more precisely in order to understand better the actual energy potential, including its seasonal and time-of-day variations. In parallel, a high-level assessment of infrastructure needs including road and power grid development; water availability; and technical, logistical and economic options for producing and evacuating the green hydrogen or green electricity should be assessed. This first assessment would guide further decisions towards the strategic opportunity beyond the medium-term needs of Uzbekistan's energy sector.

Comprehensive development and grid integration of renewable energy

Increasing the solar and wind power capacity considerably would require Uzbekistan's power system to become more flexible to accommodate the natural daily and seasonal variations and weather dependence of these energy sources. The power system's flexibility is currently limited to hydropower (governed by irrigation regimes) and gas generation that is barely sufficient, requiring coal plants to vary their output. Constructing 12 GW of new VRE capacity implies an increasing need for system balancing capacity.

Electricity grid and flexible hydro and gas-powered thermal generation are being developed and upgraded and initial steps taken to develop hydrogen, batteries and other grid integration technologies including demand-side measures. These options need to be co-ordinated with each other under a robust strategy; before organising auctions for more renewable electricity capacity, the authorities should decide how to resolve the issues with electricity system stability, curtailment and flexibility.

- Uzbekistan is actively developing **flexible gas generation.** In the first quarter of 2022, five new combustion turbines, combined-cycle and reciprocal gas engine plants with the combined capacity of 1 154 MW were added. Commissioning of a total of 2 264 MW of thermal capacity is planned for 2022-2026 (PP-72, 2021). However, the limits on variability of new gas generation due to gas network limitations deserve a closer examination.
- Hydropower provides a significant contribution to Uzbekistan's energy supply. HPPs are operated according to requirements of irrigation and have limited capacity to provide peaking and balancing services.
- Uzbekistan can enhance the co-operation with neighbouring Tajikistan and Kyrgyzstan by developing further the cross-border co-operation for peaking and balancing exchanges and joint construction of regulating HPPs in these hydro-rich countries. The country has already taken steps in this direction by negotiating the construction of two HPPs on the Zeravshan river in Tajikistan. Strengthening of the unified power system of Central Asia will allow for cross-border trade to support system flexibility and diversification of the generation sources and efficient use of border rivers.[5] This should be accompanied with the steady financial mechanisms for cross-border exchange. Development of an internal balancing market might provide the price incentives for such operations and seems to be an attractive although longer-term possibility.
- Other options for grid integration include battery and other types of storage. The government intends to include provisions for battery storage for more dispatchable renewable energy output in the latest tenders. There is ongoing research activity on hydrogen technologies; however, it needs to be put in a broader context of large-scale production and harmonisation with VRE production capacity for its optimal output. Installation of floating PV systems on the reservoirs might be a technically and economically viable solution, reducing the costs for maintenance and transmission of electricity from PV to the grid. This could use existing infrastructure and save the water from evaporation as well as save considerable land areas in productive agricultural zones.

[5] The Spanish Mercados is conducting a study on generation adequacy that may add more insight to these opportunities.

The government needs to develop a comprehensive and holistic picture of VRE grid integration with the optimised mix of these and other potential options. In view of large-scale renewable capacity to be commissioned in the coming decade, an optimised solution could deliver important technical, economic and technological benefits to the country.

Local solutions for electricity and heat supply

Large industrial projects and programmes can be complemented with customer-level initiatives. A wide range of local renewable energy applications can be triggered by informed and motivated energy consumers. Local renewable energy solutions can bring benefits in economic development, job creation, knowledge and skills dissemination through local manufacturing and installation. One good example is the government programme to install around 150 000 small solar PV systems and solar water heaters.

The government is taking various measures to encourage local renewables deployment. It has allowed net metering, and consumers with PV installations of up to 1 MW may sell electricity to the distribution companies at second-tier consumer tariffs, less distribution and transportation costs. However, the subsidised low electricity and gas tariffs are an obstacle to progress in distributed generation and local renewable energy development.

Heat accounts for almost two-thirds of Uzbekistan's TFC, and heat pumps powered by renewable electricity can be a valuable alternative to fossil fuels for heating and cooling. Cooling demand is projected to grow fast, and Uzbekistan should consider heat pump technology option more closely. In particular, solar power generation and heat pumps could help match the simultaneous need for cooling.

Reliable data on biomass use for energy are needed to support sound policies. Many experts estimate biomass use to be substantial, especially in regions outside of the gas grid, which can cause health hazards due to open fire burning. Replacing the traditional stoves of poor design with modern ones can be expected to significantly increase efficiency and safety. Information is also scarce on biogas and geothermal energy. Proper surveys need to be conducted to develop sound policies in this field. Currently there is no policy on liquid biofuels as most available residual biomass is used for heating, while the productive land is allocated for growing food crops and cotton.

Research, innovation and education

To support developing Uzbekistan's vast renewable energy potential, data and information, and knowledge and skills are needed. Areas of such work include studies on climate change impact and solar and wind power potential, hydrology measurements on small water courses, standardisation and certification of consumer-level renewable energy equipment, and hydrogen technology adaptation. Unless qualified specialists are trained, the existing minimum local workforce requirement in new PV and wind projects will boost only low-skilled employment.

The government recognises these needs and is addressing them. The Presidential Decree of April 2021 defines the Measures for the Development of Renewable and Hydrogen energy, and it establishes the National Renewable Energy Research Institute and a research centre for hydrogen energy. It also mandates establishment of bachelor's, master's and doctoral programmes compatible with EU standards in six Uzbek universities to prepare the qualified workforce for renewable and hydrogen energy. The State Committee for Standardization, Academy of Sciences and MoE are carrying out a basic

study on renewable energy standards of International Electrotechnical Commission and ISO, and they have been identifying a list of standards required for adaptation. In April 2022, the MoE accredited a laboratory for testing and certifying renewable and hydrogen energy technologies for testing of PV modules.

Next, the government plans to conduct scientific and technical research in co-operation with leading Western partners and develop a national hydrogen strategy. These activities need to be supported and strengthened further with transferring state-of-the-art knowledge and skills in renewable energy technologies to Uzbekistan.

Recommendations

The government of Uzbekistan should:

- Continue with its commendable efforts to create a vibrant and diverse renewable energy sector to meet domestic energy demand and also build capacity for exports.
- Develop a strategic vision for large-scale renewable power deployment, including for electricity or hydrogen exports.
- Closely co-ordinate the renewable energy development plans and electricity grid development plans, generation capacity increases, and cross-border trade and storage.
- Strengthen transparency and competition in large-scale projects, and maintain and develop open auctions. Ensure wider diversity of projects and developers to minimise the business and technical risks.
- Facilitate renewable energy development by reducing fossil fuel subsidies and establishing a competitive electricity market, including balancing mechanisms.
- Strengthen policies to develop small-scale distributed projects, including small hydro, solar PV and heat, and biomass and biogas, to contribute to energy supply, job creation, and development of small and medium-sized enterprises. Compile, through measurements and surveys, data and information on these renewable energy resources and consumption to support the policies.
- Ensure sufficient capacity and skills of qualified specialists to support the rapid growth of industrial and small-scale renewable energy by developing educational programmes and training at several levels.
- Provide more data and information to support renewable energy development, in particular
  - increase the accuracy and coverage of solar and wind measurements
  - measure hydrology on small rivers
  - monitor biomass and biogas use
  - compile an inventory of geothermal resources.
- Continue and strengthen measures to support science, research and innovation, and education in renewable energy to deploy innovative technologies and solutions, including green hydrogen, energy storage, floating solar PV and solar thermal.

References

Dungboyev, S., A. Karimov and N. Karshiyeva (2020), Questions of development and use of renewable energy sources for low power enterprises, https://www.e3s-conferences.org/articles/e3sconf/pdf/2020/76/e3sconf_rses2020_01132.pdf.

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

IEA (2022b), *Solar Energy Policy in Uzbekistan: A Roadmap*, https://www.iea.org/reports/solar-energy-policy-in-uzbekistan-a-roadmap.

IEA (2020), Uzbekistan energy profile, https://www.iea.org/reports/uzbekistan-energy-profile.

IEA (2018), *World Energy Outlook 2018,* https://www.iea.org/reports/world-energy-outlook-2018.

ISEI (International Solar Energy Institute) (2019), Международный институт солнечной энергии. Развитие возобновляемой энергетики в Узбекистане: современное состояние, проблемы и пути их решения (presented by Нураддин Матчанов) [International Solar Energy Institute. Development of renewable energy in Uzbekistan: the current state, issues and solutions (presented by Nuraddin Matchanov)], https://www.carecprogram.org/uploads/5.-ISEI_RE-development-in-UZB-ru.pdf.

PP-44 (2021), Presidential decree on additional measures for hydropower development https://lex.uz/ru/pdfs/5769775.

PP-5063 (2021), ПП-5063-от 09.04.2021. О мерах по развитию возобновляемой и водородной энергетики в Республике Узбекистан [On Measures to Develop Renewable and Hydrogen Energy in The Republic of Uzbekistan], https://lex.uz/ru/docs/5362035.

PP-72 (2021), ПП-72-сон 30.12.2021. Об утверждении Инвестиционной программы Республики Узбекистан на 2022-2026 годы и внедрении новых подходов и механизмов по управлению инвестиционными проектами (lex.uz).

PP-4477 (2019), ПП-4477-сон 04.10.2019. Об утверждении Стратегии по переходу Республики Узбекистан на «зеленую» экономику на период 2019-2030 годов (lex.uz).

PP-4422 (2019), ПП-4422-сон 22.08.2019. Об ускоренных мерах по повышению энергоэффективности отраслей экономики и социальной сферы, внедрению энергосберегающих технологий и развитию возобновляемых источников энергии (lex.uz).

RES Law (2019), Law of The Republic of Uzbekistan on The Use of Renewable Energy Sources LRU-539 от 21.05.2019. On the use of renewable energy sources (lex.uz).

Uzbekistan, MoE (Ministry of Energy) (2022), Минэнерго: За три месяца введено в эксплуатацию 5 новых ТЭС [Ministry of Energy: In three months 5 new TPPS were commissioned], https://minenergy.uz/ru/news/view/1919.

Uzbekistan, MoE (2021), A Carbon neutral electricity sector in Uzbekistan: Summary for policymakers, https://minenergy.uz/uploads/57c6df8d-6ec0-8362-504a-fb3162895df6_media_.pdf.

Uzbekistan, MoE (2020), CONCEPT NOTE for ensuring electricity supply in Uzbekistan in 2020-2030 (minenergy.uz).

Uzbekistan, MoE PPT (2022), Renewable energy in Uzbekistan, a PP presentation: Development of Renewable Energy sources in Uzbekistan (unescap.org).

Uzhydromet (2016), Third National Communication of the Republic of Uzbekistan under the UN Framework Convention on Climate Change,

https://unfccc.int/sites/default/files/resource/TNC%20of%20Uzbekistan%20under%20UNFCCC_english_n.pdf.World Bank (2020a), Global Solar Atlas: World, https://globalsolaratlas.info/download/world; and Global Solar Atlas: Uzbekistan, https://globalsolaratlas.info/download/uzbekistan.

World Bank (2020b), Global Wind Atlas: Uzbekistan, https://globalwindatlas.info/area/Uzbekistan.

7. Energy efficiency

Key data

(2020 provisional)

TFC: 33.1 Mtoe (natural gas 62.6%, electricity 13.5%, oil 11.9%, district heat 8.1%, coal 3.9%), -13.8% since 2010

Consumption by sector: residential 38.9%, industry 21.0%, services/other 21.9%, transport 18.2%

Energy consumption (TFC) per capita: 0.97 toe (world average 2019: 1.30 toe), -28% since 2010

Energy intensity (TFC/GDP): 126 toe/USD million PPP (world average 2019: 78 toe/USD million PPP), -52% since 2010

* Reliable data on solid biofuel consumption not available.

Overview

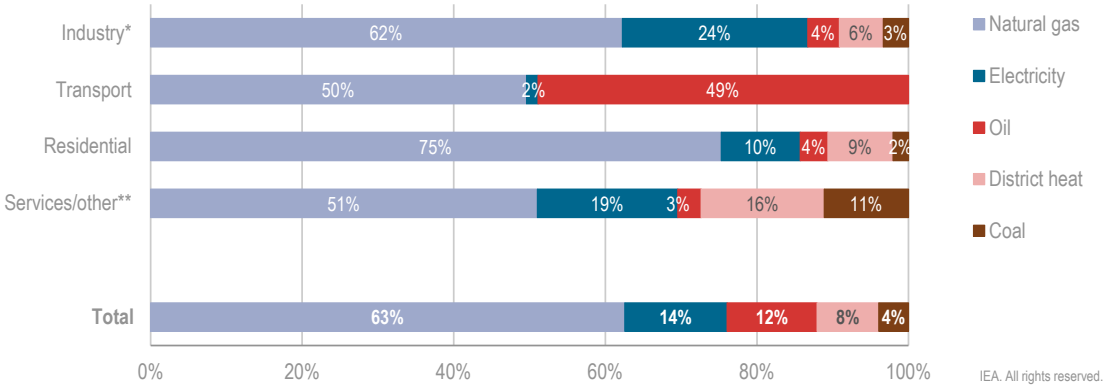
Despite a significant decline in energy intensity since 2010, Uzbekistan is one of the world's most energy-intensive economies. The residential and industry sectors account for the largest share of TFC as well as energy efficiency potential. Natural gas is the main source of TFC across all sectors including transport, where consumption levels have increased considerably since 2016. Data quality issues limit detailed analyses of sectoral consumption and energy efficiency trends.

Uzbekistan has a basic policy framework for energy efficiency accompanied by sector-specific strategies and targets. However, there are governance challenges in terms of the implementation of measures and a lack of clear long-term energy savings targets accompanied by robust monitoring and enforcement mechanisms. Responsibility for energy efficiency policy making is shared across multiple ministries and authorities, creating further challenges in terms of central policy co-ordination and deployment. Significant energy subsidies further complicate the success of Uzbekistan's energy efficiency agenda.

Energy consumption

Uzbekistan's TFC amounted to 33.1 Mtoe in 2020, a decrease of around 14% since 2010. At over 60%, natural gas represented by far the largest share of TFC in Uzbekistan in 2020, followed by electricity (13.5%), oil (11.9%) and DH (8.1%). Coal use was negligible in comparison at just under 4%.

Figure 7.1 Total final consumption by source and sector, 2020

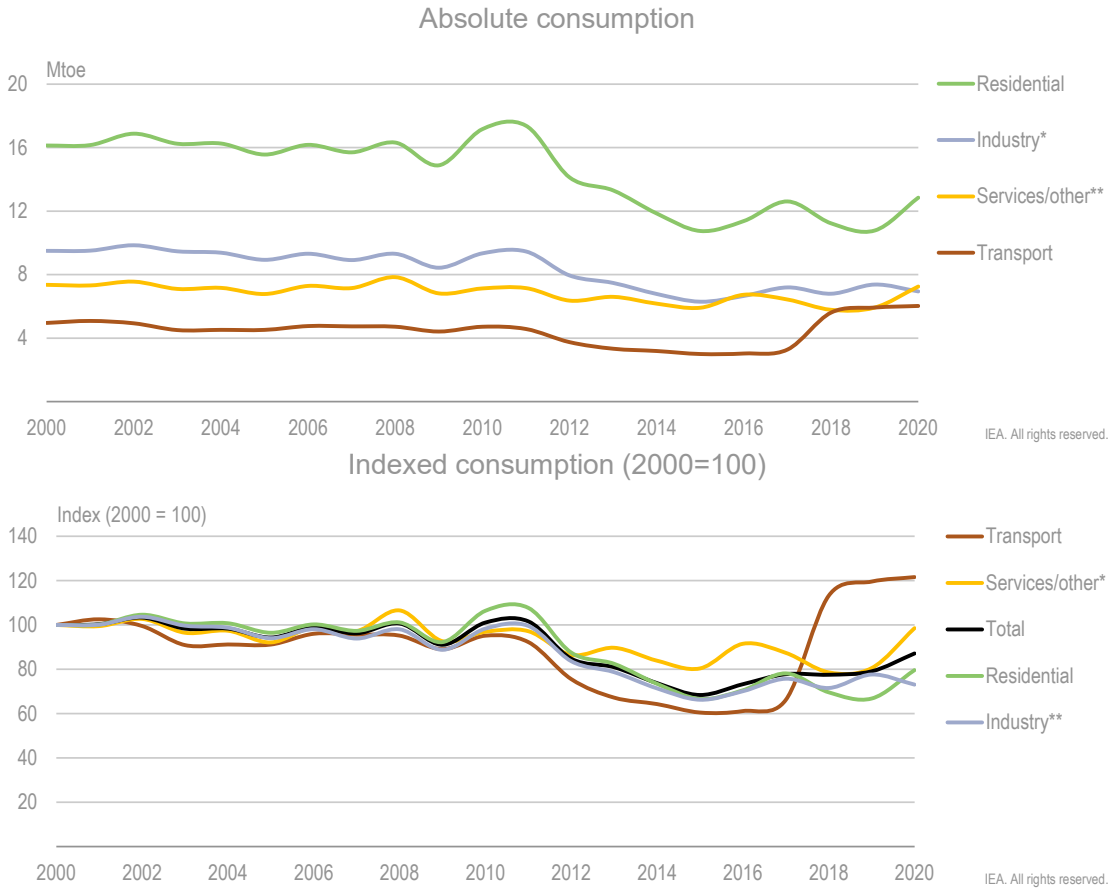


Natural gas is the largest energy source in all sectors, with oil use predominant in transport.

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

The residential sector accounts for the largest share of TFC in Uzbekistan, despite a decline in absolute consumption and sector share since 2010. It accounts for almost 40% of TFC in 2020. Industry is next, at nearly 21%, followed by transport (18%). Commercial and public services, agriculture and forestry amounted to 22%. While TFC in industry and services/other has declined since 2010, transport sector TFC has nearly doubled since 2016.

Figure 7.2 Uzbekistan's final consumption by sector, 2000-2020

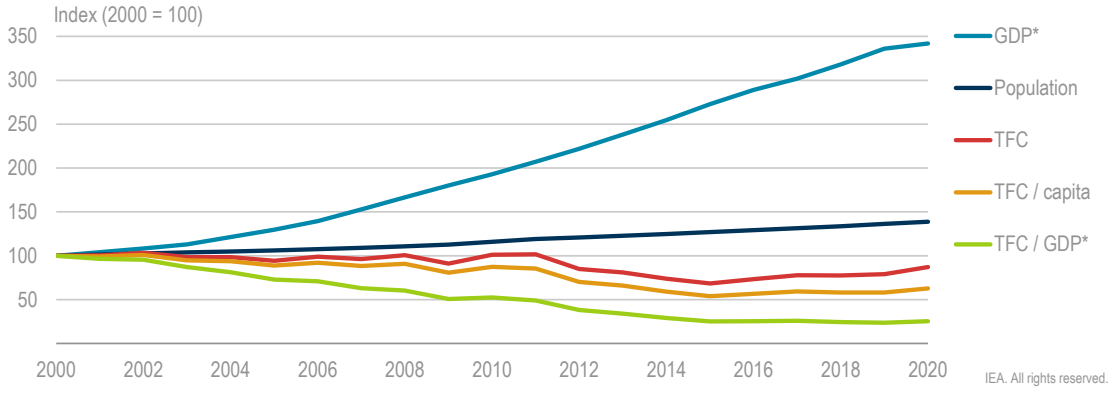


Transport sector TFC rose sharply after 2016 while TFC in other sectors stayed flat or declined.

* Includes non-energy use.
** Includes commercial and public services, agriculture, forestry, and non-specified consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

The decline in overall TFC since 2000 contrasts sharply with a marked increase in GDP over the same period, along with a nearly 40% increase in population.

Figure 7.3 Uzbekistan's energy consumption and drivers, 2000-2020

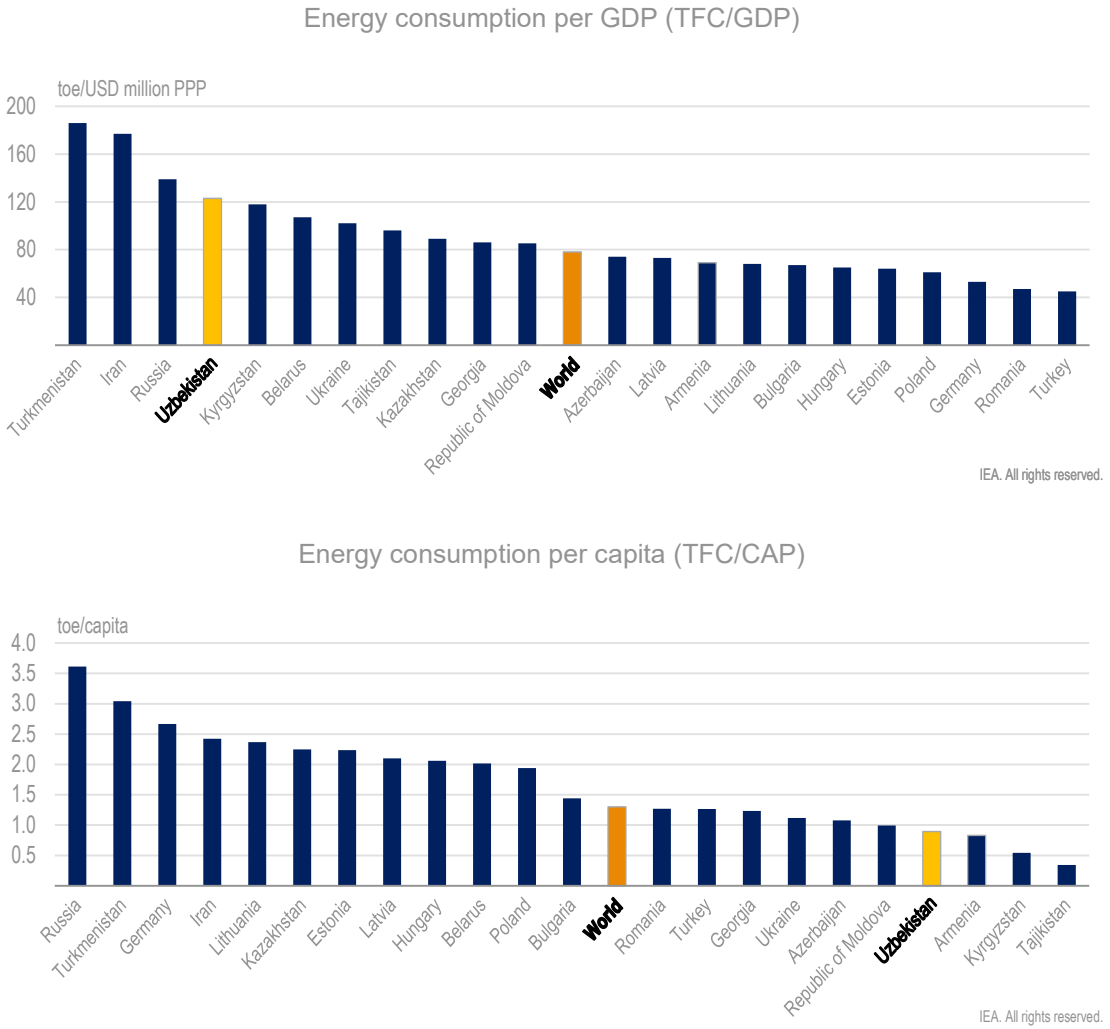


GDP has more than tripled since 2000, with TFC declining over the same period.

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

Despite declining by nearly 30% since 2010 and despite an apparent decoupling of GDP growth and TFC since 2000, Uzbekistan remains one of the most energy-intensive economies in Central Asia and its intensity per unit of GDP is more than 50% above the world average. In contrast, TFC per capita in Uzbekistan is one-quarter below the world average (0.97 versus 1.30 tonnes of oil equivalent (toe) per capita in 2019) and two-thirds below the IEA average (2.90).

Figure 7.4 Energy intensity in Uzbekistan and selected countries, 2019



Uzbekistan's energy intensity is well above the world average while TFC per capita is slightly below.

Notes: CAP = capita. TFC does not include the energy transformation sector. GDP expressed in constant 2015 USD billion at PPP.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Trends by sector

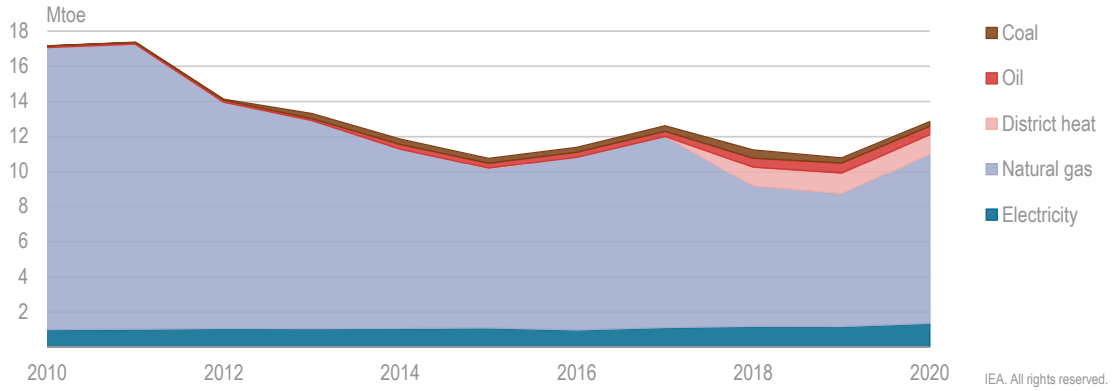
Residential

Natural gas is by far the largest source of TFC in the residential sector, with electricity (mainly from natural gas) accounting for a minor yet consistent share of TFC since 2010.

Nonetheless, some movement can be observed in terms of other sources, notably DH, contributing to TFC since 2016. Coal and oil use have also increased slightly over this period. In addition, natural gas use declined significantly from 2010 to 2020, from just above 16 Mtoe to just below 10 Mtoe, driven in part by tariff increases.

Household energy use is relatively inefficient. The specific energy consumption per square metre of living area in Uzbekistan is almost three times higher than in European countries with similar climatic conditions (e.g. Spain) (UNECE, 2020).

Figure 7.5 TFC in Uzbekistan's residential sector by source, 2010-2020



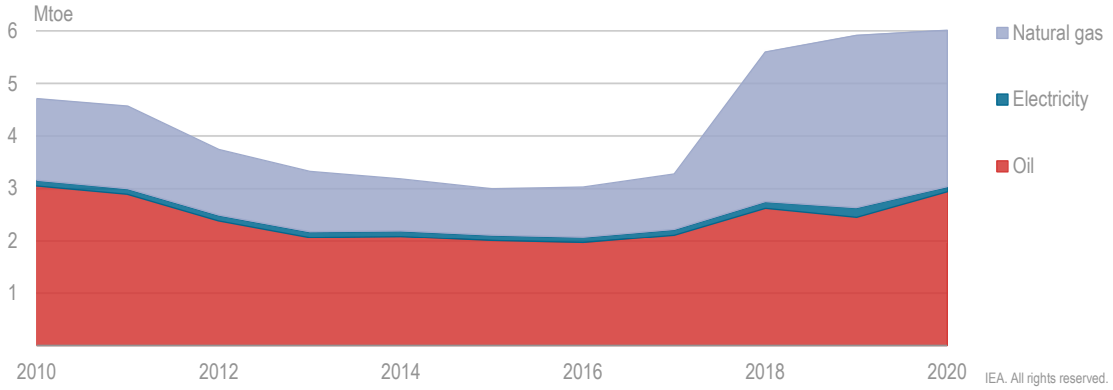
District heat and other fuels have increased slightly since 2016, but natural gas remains predominant.

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

Transport

Transport sector TFC increased significantly after 2016 due to a spike in the use of natural gas, e.g. CNG. Official sources are not able to provide further information on the origins of this increase, which may be due to discrepancies between available data sets and collection methodologies (ECS, 2022). Half of passenger cars and trucks use CNG (methane), 36.6% gasoline, 13% LPG and 0.4% use diesel (gasoil) (UNECE, 2020).

Figure 7.6 TFC in transport sector by source, 2010-2020



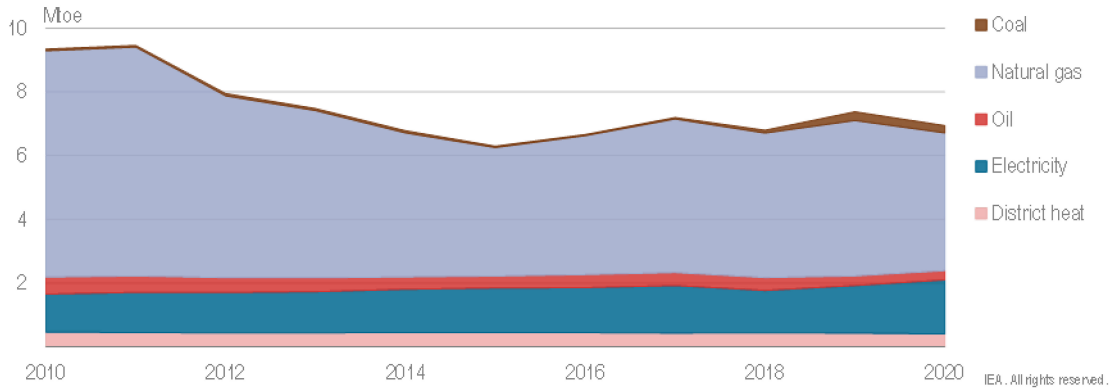
Natural gas use for transport nearly doubled between 2017 and 2019.

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

Industry

Much as it is in the residential sector, natural gas is the predominant source of TFC in industry, with the consumption of oil, electricity and DH remaining virtually unchanged since 2010. Natural gas consumption decreased considerably between 2011 and 2015, with a moderate rebound by 2020. Coal use increased slightly since 2018.

Figure 7.7 TFC in Uzbekistan's industry sector by source, 2010-2020

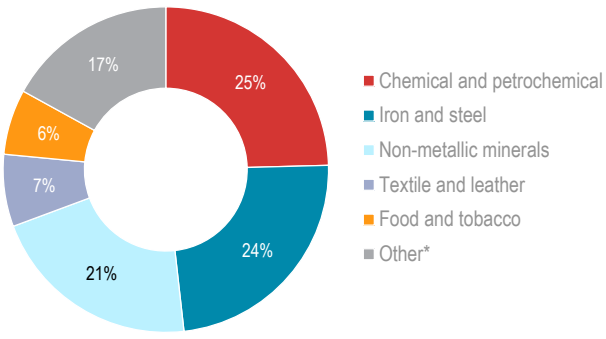


Sources of TFC in industry remain relatively stable except for a decline in natural gas since 2011.

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

With respect to consumption across industry subsectors, chemicals and petrochemicals account for about one-quarter (25%) of the total, followed by iron and steel (24%) and non-metallic minerals (21%). The remaining consumption is split across textiles and leather (7%) and food and tobacco (6%), with a variety of other subsectors, including transport equipment; paper, pulp and printing; machinery; non-ferrous metals; and unspecified industrial consumption accounting for the remaining 17% of the total.

Figure 7.8 Energy consumption in manufacturing industry subsectors, 2020



Chemicals and petrochemicals account for the largest share of industrial energy use in Uzbekistan.

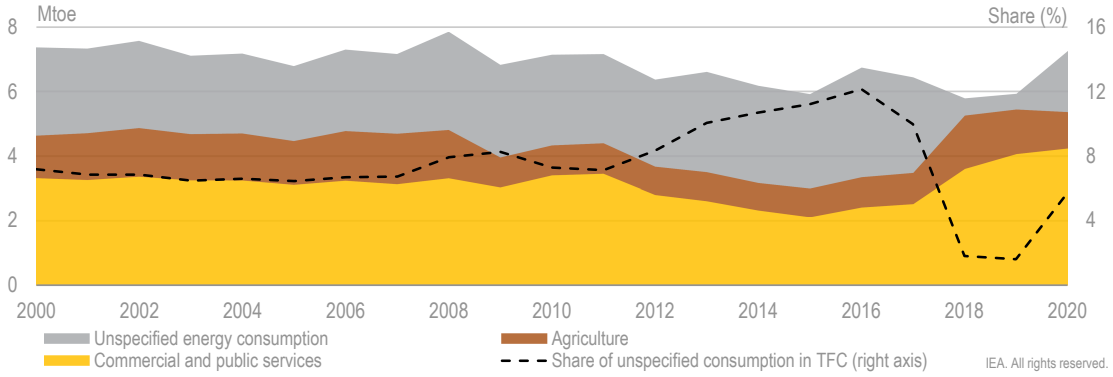
* Includes transport equipment; paper, pulp and printing; machinery; non-ferrous metals; and unspecified industrial consumption.
Note: Manufacturing industry excludes mining, quarrying and construction; excludes non-energy uses.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Historical data for these subsectors cover only a limited number of years and is based in part on IEA estimates. The observed decline in manufacturing industry energy intensity (MJ/USD PPP 2015) may rather result from improved data collection than from stronger energy efficiency measures.

Services and agriculture

Uzbekistan's remaining TFC is consumed in services, agriculture and unspecified other activities (7.3 Mtoe or 22% of TFC in 2020). However, the majority of this consumption was not allocated to any sector until 2018, limiting further sectoral analysis.

Figure 7.9 TFC in other sectors, 2000-2020



Commercial and public services and agriculture account for the majority of TFC in other sectors.

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

Institutional framework

The main body responsible for developing energy efficiency policies in Uzbekistan is the MoE, created in February 2019. Within the MoE, the Department of Energy Efficiency and Energy Saving in Economy Sectors and the Social Sphere manages technical and other aspects related to energy efficiency policies and measures. The Ministry of Economic Development and Poverty Reduction, however, has overarching responsibility for the delivery of the Green Economy Transition Strategy for 2019-2030, which includes efficiency objectives (see below).

A variety of territorial commissions and state authorities also carry responsibilities related to the implementation of energy efficiency policies, whereby the Republican Commission is the co-ordinating body for ensuring control and interaction of state and economic management bodies in the field of energy efficiency. In addition, the Ministry of Housing and Communal Services provides information on any available energy efficiency projects and programmes in the residential sector, while the Ministry of Construction is responsible for adopting and implementing any new construction and urban planning standards designed to improve buildings energy efficiency.

The Ministry of Economic Development and Poverty Reduction is the central public authority responsible for promoting industry sector policies, including energy efficiency programme development. The Ministry of Transport has responsibility for transport matters, while the Uzstandard Agency develops and approves minimum energy consumption standards for certain types of equipment.

Policies and measures

Policies and measures to promote energy efficiency in Uzbekistan have been in place since 1997 and include codes for the construction of buildings, MEPS for energy-using equipment and appliances, audit requirements for energy-intensive industries, and import restrictions on inefficient vehicles. This legislative framework, as discussed in the subsequent section, is complemented by several programmes and strategies including sector-specific energy efficiency targets and objectives adopted since 2017. The government of Uzbekistan has also identified energy efficiency as a strategic priority, notably in the buildings and industry sectors.

Despite a relatively long-standing and comprehensive policy agenda, Uzbekistan faces challenges around implementation and enforcement of adopted measures. Public awareness about energy efficiency is low. In addition, the heavy subsidisation of energy prices particularly for residential consumers undermines the effectiveness of energy efficiency policy making in Uzbekistan, creating disincentives for investments in more efficient technologies and reducing the impact (e.g. lessening cost savings potentials) of cornerstone energy efficiency policies such as MEPS.

Uzbekistan relies on a system of cross-subsidisation, whereby proceeds from industrial or commercial energy payments are used to subsidise energy tariffs for households. In total, cross-subsidies to residential consumers in Uzbekistan were estimated at nearly USD 500 million in 2019 for electricity and natural gas. According to available estimates, subsidies between 2010 and 2019 amounted to nearly USD 60 billion. While reform efforts are under way to phase out subsidies by 2030, estimates suggest Uzbekistan will spend a further USD 55 billion on subsidies during this phase-out period (Energy Charter, 2021).

In addition to creating disincentives for energy efficiency, subsidies can lead to key infrastructure underinvestment, transmission losses and power outages. Subsidised energy prices also generally do not reflect the real cost of energy production, transmission and distribution, notably for residential consumers. Historically, electricity production costs have been on average more than one-third above tariffs charged to end users (ECS, 2022). While this gap was partially addressed through tariff increases between 2018 and 2019, resulting in an increase of coverage from 70% to 92%, underinvestment in energy infrastructures remains a challenge in Uzbekistan and tariff reforms are ongoing (see chapters on electricity and natural gas).

Legislative framework

The 1997 Law on Rational Energy Use is Uzbekistan's first law targeted at improving energy efficiency. It creates a basic legal framework related to the efficient use of energy, and focuses on supply-side issues including more efficient electricity production, transmission and distribution. The law has been amended periodically, most recently in 2020, featuring the assignment of the newly established MoE as the main body responsible for energy efficiency and the assignment of energy efficiency responsibilities across multiple state authorities (ECS, 2022).

While Uzbekistan does not have a national energy efficiency action plan, several strategies and programmes including energy efficiency measures have been adopted as part of a wider clean energy transformation agenda, along with additional legislative acts in the form of presidential rulings. These include a 2017 presidential ruling (3012) on a programme of

measures[6] to improve energy efficiency that features several targets including the replacement of more than 17 000 boilers in public-sector bodies, the replacement of just under 900 pumps and over 1 500 electrical motors in water utilities, and an 8-10% decrease in manufacturing energy intensity across key sectors. To date, no information is available on progress towards these targets, however.

Subsequently, a 2019 presidential ruling (4422) on energy efficiency and renewable energy[7] announced new regulations for classifying new and existing buildings based on energy performance. The ruling provides a legal framework for regulating the activities of energy service companies (ESCOs), including rules for energy auditors and legal provisions to allow public authorities to enter energy performance contracts. Ruling 4422 also stipulates that public-sector bodies should improve the energy performance of their buildings using efficient technologies, whereby a 2020 presidential decree (5963) on the construction sector[8] requires all publicly funded projects to undergo from 2021 a survey to determine conformity with energy efficiency requirements. Ruling 4422, which led to the creation of a dedicated department for energy efficiency within the MoE, further calls for the introduction of energy management systems aligned with the ISO 50001 standard at all energy-intensive enterprises and public authorities by 2023 (ECS, 2022).

A Green Economy Transition Strategy for 2019-2030 was also adopted in 2019, featuring a target to improve industrial efficiency by 20% and general provisions for improve transport efficiency. In 2020, a further presidential ruling (4779) on additional measures to increase energy efficiency[9] came into effect featuring several industry-specific measures, including a roadmap to improve energy efficiency in energy-intensive industries and containing a list of nearly 300 large industrial enterprises that must undergo energy audits by 2022. The ruling also includes a target to reduce Uzbekistan's energy intensity by a factor of 1.5 by 2030, whereby it is noteworthy that this figure differs with the target set in the Green Economy Transition Strategy for 2019-2030, which targets an energy intensity reduction by a factor of 2 during the same period (ECS, 2022).

Buildings

Buildings constitute the largest share of TFC in Uzbekistan. With significant energy efficiency potential – estimated to range from 50% to over 70% in residential dwellings, for example – buildings are an important part of energy efficiency efforts in Uzbekistan. To date, however, no specific energy efficiency targets have been set for the buildings sector, although a new decree announcing a buildings sector programme is expected in September 2022. Much like Uzbekistan's industrial facilities, most buildings were constructed during the Soviet era and without conformity to any energy efficiency requirements, e.g. insulation (ECS, 2022).

[6] Ruling of the President on a Programme of Measures to Further Develop Renewables, Improve Energy Efficiency in the Economy Sectors and the Social Sphere in 2017-2021, No. 3012 dated 26 May 2017.
[7] Ruling of the President on Accelerated Measures to Increase the Energy Efficiency of Economy Sectors and the Social Sphere, Deploy Energy Saving Technologies and Develop Renewable Energy Sources, No. 4422 dated 22 August 2019.
[8] Decree of the President of on Additional Measures to Enhance the Reforms in the Construction Sector of the Republic of Uzbekistan, No. 5963, dated 13 March 2020.
[9] Ruling of the President on Additional Measures to Reduce the Dependence of Economic Sectors on Fuel and Energy Products by Increasing the Energy Efficiency of the Economy and Using Available Resources, No. 4779, dated 10 July 2020.

For new and renovated buildings, minimum energy performance requirements notably with respect to heating and ventilation have been in place in Uzbekistan as part building codes since at least 2000, whereby the issuance of an energy performance certificate (EPC) has been required for all new buildings in Uzbekistan since 2016. From 2020, all new public or commercial buildings must also receive an energy audit passport before commissioning, although buildings that obtain a green building certification[10] are exempt from this requirement. While requirements for integration of renewable energy are mandatory for new multistorey commercial buildings in cities, these have not yet been implemented, according to available information. Codes for new residential buildings do not contain any requirements for the inclusion of renewable energy sources, however (ECS, 2022).

Any new building projects that use public funding are required to undergo a survey to determine whether energy efficiency requirements are being met. In addition, public buildings constructed from 2020 require the mandatory installation of energy-efficient gas heating systems as well as sensors integrated with LED (light-emitting diode) sources for lighting systems.

Despite these policy elements, little information is available on the energy performance of buildings in Uzbekistan. In addition, while energy performance requirements exist for renovated buildings in Uzbekistan, there are no targets or comprehensive measures in place for improving the energy performance of existing buildings, e.g. through retrofits, although EPC requirements for existing buildings are under consideration.

In terms of the development of a market for energy services and ESCOs, presidential Ruling 4422 includes specific provisions for these. However, there is currently little evidence of ESCO market activity in Uzbekistan, either in public buildings or industrial facilities, and secondary legislation to further support the sector has been stalled in the Ministry of Finance.

Heating

Heating accounts for the lion's share of building energy use in Uzbekistan, whereby buildings consume nearly 80% of total heat generated by outdated district systems built during the Soviet era. Over 40% of the more than 45 000 multi-apartment buildings in Uzbekistan are connected to DH systems that rely on natural gas. At present, there are no policy mechanisms in place to shield vulnerable consumers from price increases in gas, which would have a knock-on effect on home heating costs (ECS, 2022).

Refurbishment and renewal of outdated and inefficient heating systems and networks also present a key challenge for policy makers. As part of a 2017 presidential ruling (5017) targeted at improving the management of the system of housing and communal services,[11] the government of Uzbekistan outlined a modernisation programme covering local boiler houses and DH networks, among others. A further law on heating supply with measures to improve DH systems is currently in drafting phase (ECS, 2022).

Subsidies also play an important role in terms of heating energy efficiency, notably with respect to DH, where tariffs are kept below economically sustainable levels in terms of

[10] Such as LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment's Environmental Assessment Method).
[11] Ruling of President on the Measures to Further Improve the Management of Housing and Communal Services, No. 5017, dated 18 April 2017.

ensuring the upkeep of DH systems and the reduction of losses. While available data are limited, estimates put the value of DH subsidies in 2020 at above USD 30 million.

Lighting, appliances and equipment

A MEPS framework for appliances has been in place in Uzbekistan since 2016, covering 18 product groups and including washing machines and refrigerators as well as lighting and air conditioners. MEPS are combined with a labelling programme based on an A-to-G class rating system, with A being the most efficient and G being the least efficient. The government of Uzbekistan banned the sale of incandescent lamps above 40 watts (W) in 2017, and introduced a progressive phase-out of inefficient equipment, banning the import and sale of G-rated appliances from 2017, F-rated appliances from 2018 and E-rated appliances from 2019. Further measures introduced as part of regulation 4422 cited previously also include class D appliances in the 2019 sale and import ban.

Specific measures for social facilities, including the mandatory use of efficient lighting and equipment, have also been introduced, and the government of Uzbekistan is providing limited support for the purchase of efficient gas boilers. In the area of lighting, a ban on the sale of incandescent lamps above 40 W has been in place since 2017. Such lamps are still available on markets, however, and consumers are deterred by higher upfront purchase prices of LED lamps.

Transport

While the sharp increase in transport TFC since 2016 may be due to data inconsistencies or errors, other evidence points to growing demand in the sector. Vehicle ownership notably increased by nearly 15% between 2019 and 2021, with approximately 3.5 million cars currently in circulation, equivalent to 100 cars per 1 000 inhabitants. This motorisation rate is expected to continue to rise rapidly as the population grows and becomes wealthier, presenting a growing challenge for transport infrastructure, energy use and emissions, particularly in the absence of targeted efficiency policies (ECS, 2022). For example, reaching the EU level of around 500 cars per 1 000 inhabitants would add more than 14 million cars on Uzbekistan's roads.

The framework for energy efficiency in transport in Uzbekistan is at an early stage of development. While there are no fuel efficiency standards in place in the country, certain classes of inefficient vehicles – Euro-3 and Euro-4 or equivalent – are no longer permitted for imports from 2022 (Euro-3) and 2023 (Euro-4). There are also rules in place to prohibit from 2020 the production of fuel for Euro-4 vehicles. Beyond these measures, however, there are no specific vehicle emissions standards in place in Uzbekistan. A labelling regime to indicate vehicle fuel economy and/or carbon footprint is also not currently in place.

Additional efforts to improve transport sector efficiency in Uzbekistan are included in the Green Economy Transition Strategy for 2019-2030, which includes objectives to improve public transport, which is generally underutilised in Uzbekistan due to the large and rural nature of the country, and to expand the production of more efficient vehicle classes as well as electric and hybrid vehicles. Furthermore, the government published a draft transport sector strategy in 2019. The draft, which remains under consideration, includes proposals to provide financial compensation and tax incentives for retrofitting of existing vehicles with more efficient engine types of alternative fuels (ECS, 2022).

Industry and agriculture

With most facilities built during the Soviet era, Uzbekistan's industry has considerable energy efficiency potential, estimated at above 40%, notably in processing and manufacturing. As noted previously, the Green Economy Transition Strategy for 2019-2030 and Ruling 4779 contain industry-specific provisions and targets. However, while Ruling 4779 contains de facto provisions banning the import of certain inefficient industrial equipment, energy performance standards have not been introduced for industrial equipment, e.g. pumps and motors (ECS, 2022).

Since 2006, energy audits and periodic inspections have been mandatory for industries above a certain consumption threshold. While the implementation of findings from energy audits is not mandatory, companies that comply with this requirement are eligible for preferential financing from international lenders, as detailed below.

In parallel and with a focus on the public sector, energy-intensive industries with public or state funding must deploy energy management systems. Available evidence suggests that auditing and, notably, implementation of their findings is limited, however, which may be partly due to the level of capacity and knowledge among energy auditors.

Historically, industrial energy users, much as in other sectors, have benefited from subsidised tariffs for gas and electricity. In 2019, the gas tariffs for certain industrial consumers were raised by 58%. The tariff increase was intended at least in part to fund cross-subsidies for residential gas consumers, and also to incentivise industries to operate more efficiently. There is little evidence to date on whether this approach has been effective, however, and industrial energy users as well as utilities are able to pass on the higher costs of energy to end consumers, while no provisions exist to shield vulnerable consumers from price increases (ECS, 2022).

Agriculture consumes one-quarter of the electricity in Uzbekistan, mainly for irrigation in outdated and inefficient pumping stations, most of which date from the Soviet era. To modernise and reconstruct these pumping stations, the Ministry of Water Resources, which is in charge of irrigation, has adopted a Concept for the Development of the Water Sector of the Republic of Uzbekistan for 2020-2030. By 2030, the concept aims to replace 1 750 pumping units, more than 33% of the total, and 2 100 electric motors, more than half of the total. This more energy-efficient equipment is expected to reduce annual electricity consumption by pumping stations in the system of the Ministry of Water Resources to 7.0 TWh in 2025 and to 6.0 TWh in 2030 (Ministry of Water Resources, 2020).

Financing

The government of Uzbekistan has made some progress to support the financing of energy-efficient technologies, though there are challenges with respect to implementation. Ruling 4422 cited above stipulates that households should receive a partial compensation (30%) for the purchase of solar water heaters and more efficient gas heating appliances. Households as well as legal entities can also obtain partial compensation of interest when purchasing energy-efficient equipment on credit. Low energy tariffs and the relatively high upfront cost of these technologies cast doubts on the likelihood of such schemes being deployed at scale in markets (ECS, 2022).

A cross-sectoral fund for energy efficiency, meanwhile, was established in 2020 as part of Ruling 4779 cited above, although the creation of this fund had already been called for in the 1997 Law on Rational Energy Use. The fund is to be financed based on a 5% annual allocation of proceeds from fossil fuel industries and the power sector. There are concerns, however, about the co-ordination of the fund since it is managed by the Ministry of Economic Development and Poverty Reduction rather than the MoE.

Outside of direct efforts by the government of Uzbekistan, IFIs play an important role in supporting energy efficiency as well as wider clean energy transition activities in Uzbekistan. The World Bank, for example, has provided over USD 320 million in loans for industrial energy efficiency investments, with more than USD 100 million provided in additional loans through a collaboration with the European Investment Bank (EIB). The EBRD has a major investment portfolio in Uzbekistan at above USD 1 billion, including a USD 100 million project to modernise district heating infrastructure in Tashkent (ECS, 2022), while the United Nations Development Programme (UNDP) has allocated nearly USD 140 million towards a programme targeted at energy efficiency and renewable energy installations in rural dwellings (UNDP, 2022).

Assessment

Energy consumption

While TFC has fallen by 14% since 2010 to 33.1 Mtoe in 2020, and despite GDP growth over the same period, Uzbekistan remains one of the most energy-intensive economies in Central Asia, with intensity per unit of GDP more than 50% above the world average.

At more than 39% of TFC in 2020, the residential sector accounts for the largest share of TFC in Uzbekistan. Industry accounts for 21%, followed by transport (18%). Services, agriculture, and forestry account for just above 20%. Transport sector TFC has nearly doubled since 2016, although available data may contain errors, while TFC in industry and services has declined since 2009.

Natural gas is by far the largest source of TFC in Uzbekistan, at 63%. Electricity is next at almost 14%, followed by oil at nearly 12% and DH at 8%. Coal use is negligible at 4%.

Energy efficiency data need to be improved in Uzbekistan, particularly sectoral data, to enable to identify and explain trends in energy consumption, such as dips or spikes in demand, notably in the transport sector, and develop effective evidence-based policies and measures.

Policies and measures

Energy efficiency legislation was first introduced in 1997. It includes codes for the construction of new buildings, MEPS for energy-using equipment and appliances, audit requirements for energy-intensive industries, and import restrictions on inefficient vehicles. Little information is available on the impact of measures adopted to date. It is unclear whether this is due to a lack of published information, poor data quality, weak implementation and enforcement mechanisms, or a combination of these factors.

Low levels of public awareness about the benefits of energy efficiency, as well as a lack of central co-ordination and coherence across multiple ministries, affect energy efficiency governance in Uzbekistan. In addition, there are numerous presidential rulings and decrees that do not necessarily provide a clear and consistent policy framework with medium- and long-term, sector-specific targets supported by secondary legislation or implementation and enforcement mechanisms.

However, like other countries that have legacy infrastructure and subsidised energy prices, there is great potential for Uzbekistan to use energy more efficiently. The IEA strongly encourages the government to view energy efficiency as a source of revenue, clean air and jobs, and to quickly adopt the laws, strategies, policies and measures needed to realise these possibilities.

Impact of subsidies

A key influencing factor for energy efficiency in Uzbekistan are subsidies and pricing mechanisms notably for natural gas, the main energy source in all sectors. While reform efforts are under way, experts broadly agree that current pricing structures limit incentives for energy efficiency improvements across key sectors of the economy, particular in buildings and industry.

In addition to disincentivising investments in energy-efficient technologies, subsidies also reduce available capital for critical expenditure on energy system infrastructure maintenance and expansion. This can lead to transmission losses and power outages while reducing available funds to expand electricity access to rural communities or improve DH infrastructure, for example. While energy tariff increases can be politically and socially sensitive, policy makers can explore support mechanisms for the most vulnerable. In addition, energy efficiency improvements notably in the residential sector can offset the impacts of tariff increases.

Buildings, appliances and lighting

Buildings constitute the largest share of TFC in Uzbekistan, with natural gas use for heating predominant notably in residential buildings. District and central heating infrastructure is outdated, requiring repair and modernisation (see the chapter on heat). Building codes and energy performance requirements for new buildings and retrofits have been in place since 2000, and a range of new measures have been introduced for existing buildings since 2017. However, the sector lacks clear targets and a coherent strategy to improve energy efficiency across both new and existing buildings, and significant energy efficiency potentials remain largely untapped.

A MEPS framework for appliances has been in place since 2016 and is accompanied by an A-to-G labelling system. The import and sale of G-rated appliances was banned from 2017, F-rated appliances from 2018 and E-rated appliances from 2019. The sale of incandescent lamps above 40 W was banned in 2017, although the measure has not been robustly enforced, with inefficient lamps still widely available. High upfront costs combined with subsidised electricity prices create important barriers to the uptake of more efficient equipment by consumers.

Industry

Industry is the second-largest energy consumer in Uzbekistan, and subsidised natural gas is the predominant fuel in industrial processes. Energy audits and periodic inspections have been mandatory for industries above a certain consumption threshold since 2006, although the implementation of audit findings has been limited. Despite reforms, subsidies for industrial energy use, a lack of energy performance standards for industrial equipment and overlaps between ministries, e.g. lack of ministerial co-ordination, are blocking the achievement of significant energy efficiency potential in industry.

Transport

Based on available data, transport sector energy use has increased sharply since 2016. Limited measures are in place for energy efficiency in transport in Uzbekistan. Euro-3 and Euro-4 or equivalent passenger vehicles are no longer permitted for imports from 2022 (Euro-3) and 2023 (Euro-4), with the production of fuel for Euro-4 vehicles banned from 2020.

There are no vehicle emissions standards in Uzbekistan. A labelling regime to indicate vehicle fuel economy and/or carbon footprint is also not currently in place.

Vehicle ownership is still low in Uzbekistan, but road transport energy consumption is expected to continue to rise rapidly in the medium term, as the country's road network is improved and people become wealthier. Policy decisions are therefore critical to ensure that the transport sector develops in a sustainable and efficient manner. To improve energy efficiency and limit air pollution, the government should set minimum energy efficiency requirements or emissions limits for all vehicles imported and sold, including second-hand ones.

Recommendations

The government of Uzbekistan should:

General

- ☐ Expedite the development of a legislative framework for energy efficiency, including secondary legislation for the buildings, industry and transport sectors.
- ☐ Develop an energy efficiency action plan containing clear baselines and targets as well as specific measures across the buildings, industry and transport sectors, and consider creating a dedicated energy efficiency agency.
- ☐ Develop energy efficiency indicators according to the international methodology to track the impact of sectoral energy efficiency policies (industry, transport, residential, services).
- ☐ Prioritise investments to improve energy efficiency alongside renewable energy adoption.
- ☐ Increase public awareness of the multiple benefits of energy efficiency beyond energy savings.

Buildings, appliances and equipment

- ☐ Develop a buildings sector energy efficiency strategy or roadmap, including measures to improve the energy performance of existing buildings.
- ☐ Introduce and enforce minimum efficiency requirements for energy-using and energy-related products and new buildings.
- ☐ Introduce measures to support renovation of the existing building stock, especially residential and public buildings.

Industry

- ☐ Incentivise industry to implement the findings of energy audits and explore options for further energy efficiency promotion, for example through targets for savings or efficiency.

Transport

- ☐ Develop a comprehensive policy framework to address the transport sector's energy use and emissions.
- ☐ Introduce and enforce minimum fuel efficiency standards for vehicles.
- ☐ Continue to develop public transport and encourage its use.

References

ECS (Energy Charter Secretariat) (2022), *In-Depth Review of the Energy Efficiency Policy of the Republic of Uzbekistan*, https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Uzbekistan_2022__en.pdf.

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

UNDP (United Nations Development Programme) (2021), Prospects for the development of energy-efficient buildings in Uzbekistan, https://www.uz.undp.org/content/uzbekistan/en/home/presscenter/pressreleases/2021/12/prospects-for-the-development-of-energy-efficient-buildings-in-u.html.

UNECE (United Nations Economic Commission for Europe) (2020), *Environmental Performance Reviews: Uzbekistan*, Environmental Performance Reviews Series No. 52, https://unece.org/environment-policy/publications/3rd-environmental-performance-review-uzbekistan.

Uzbekistan, Ministry of Water Resources (2020), Concept of Development of Water Management Sector of the Republic Of Uzbekistan for 2020-2030, https://water.gov.uz/en/posts/1545735855/396.

8. Energy and climate

Key data

Total GHG emissions (2017):

Without LULUCF*: 189.2 Mt CO_2-eq,+6.7% since 1990, -5.4% since 2010

Without LULUCF* by sector: Energy 76.3%, agriculture 17.8%, industrial processes 4.5%, waste 1.4%

With LULUCF*: 180.6 Mt CO_2-eq, +10.6% since 1990, -3.5% since 2010

Energy-related emissions (2020):

Fugitive GHG emissions:** 25.5 Mt CO_2-eq, +21.5% since 1990, -20.0% since 2010

CO_2 emissions from fuel combustion: 109.6 Mt CO_2 (-6.9% since 1990, -8.6% since 2010)

CO_2 emissions by fuel: Natural gas 78.7%, oil 11.0%, coal 10.3%

CO_2 emissions by sector: Electricity and heat generation 40.6%, residential 22.9%, transport 14.4%, industry 10.6%, services 11.6%, other energy 5.2%

CO_2 intensity (CO_2 emissions per GDP): 0.37 kg CO_2/USD (2015 PPP) (world average 2019: 0.26)

* For non-Annex I countries of the Kyoto Protocol, recent GHG data availability is limited. The latest national inventory covers 1990-2017.
** Fugitive emissions for 2020 are IEA estimates.

Overview

Uzbekistan ratified the Paris Agreement in October 2018 and in its first NDC pledged to reduce its GHG emissions per unit of GDP by 10% from 2010 to 2030. The country had met this target already in 2013. In 2021, Uzbekistan submitted its second (updated) NDC to the United Nations Framework Convention on Climate Change (UNFCCC), raising the GHG emissions intensity target to 35% below 2010 level by 2030. Because of its projected fast population growth and the need for economic growth, Uzbekistan has so far not adopted an absolute target for GHG emissions. Energy-related emissions account for three-quarters of the total, and the single largest source of GHGs are methane leaks from the natural gas system.

GHG emissions

Uzbekistan's most recent GHG emissions data are from 2017, when emissions totalled 189.2 Mt of carbon dioxide equivalent (CO_2-eq) without LULUCF (land-use, land-use change and forestry) and 180.6 Mt CO_2-eq with LULUCF. In 1990-2017, emissions without LULUCF decreased by 6.7%, and in 2010-2017 by 5.4%.

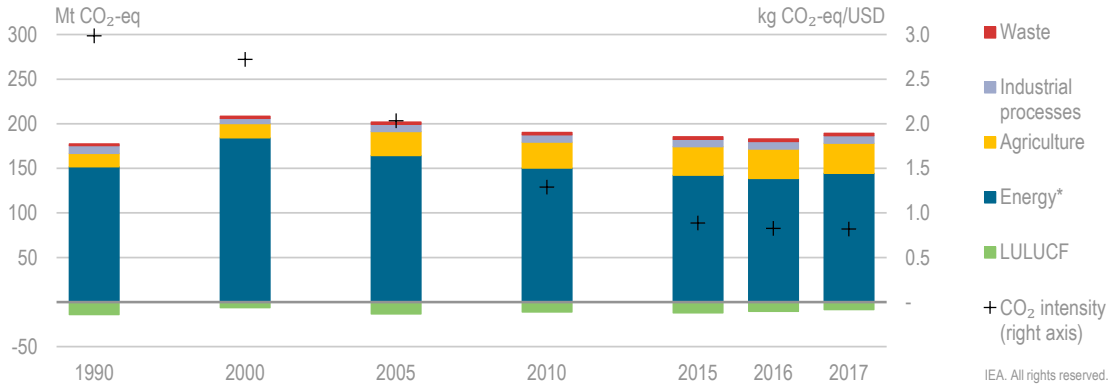
By gas, CO_2 accounted for 53.6% of total GHG emissions in 2017. Methane (CH_4) accounted for 38.6%, nitrous oxide (N_2O) for 7.6% and hydrofluorocarbons (F-gases) for 0.2%.

By emitting sector, energy accounted for 76.3% of total GHGs in 2017 and agriculture for 17.8%. Industrial processes and product use (IPPU) emitted 4.7% of the total and the waste sector 1.4%.

Since 1990, the energy sector's share in total emissions declined from 85.5% to 76.3%, while agriculture's share increased from 8.5% to 17.8%, driven by the growth in livestock and nitrogen fertiliser use. The IPPU share declined from 5.0% to 4.5%, while the waste sector share rose from 1.1% to 1.4%. Carbon sinks (LULUCF) equalled around 5-6% of total emissions in 2010-2017, partly because of forestation efforts on the drained bottom of the Aral Sea to help mitigate salinisation and associated problems.

From 1990 to 2017, GHG emissions per capita decreased from 8.6 t CO_2-eq to 5.8 t CO_2-eq and CO_2 emissions from 5.4 t to 3.1 t.

Figure 8.1 Greenhouse gas emissions in Uzbekistan by sector, 1990-2017



Uzbekistan's GHG emissions have remained remarkably stable since 2000, while its GDP has more than tripled.

* Includes fuel combustion (for power and heat generation, and for industry, transport, residential and commercial energy consumption) and fugitive emissions from fuels.
Notes: As stated in Uzbekistan's updated NDC, it commits to reduce specific GHGs (measured per unit of GDP) by 35% from the level of 2010. GDP in the chart expressed in constant 2015 USD and PPP.
Sources: Uzhydromet (2022), *First Biennial Update Report of the Republic of Uzbekistan under the UN Framework Convention on Climate Change*;GoU (2021), Updated Nationally Determined Contribution of the Republic of Uzbekistan, https://unfccc.int/sites/default/files/resource/FBURUZeng.pdf.

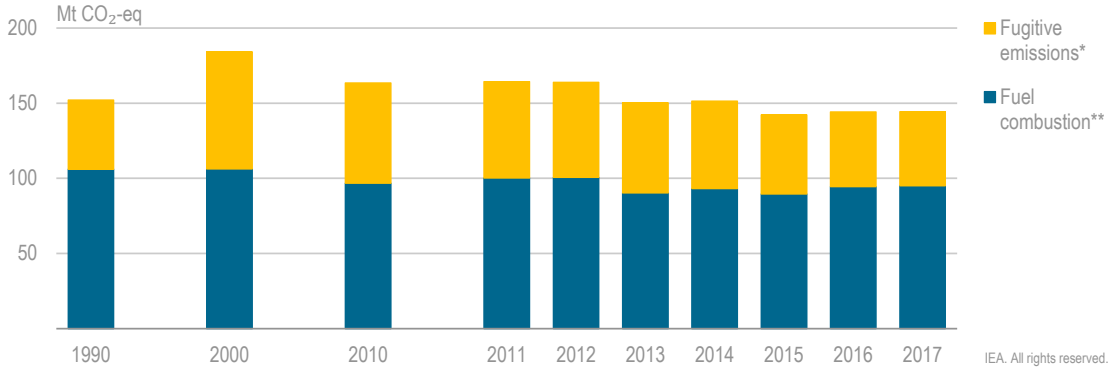
Energy-related GHG emissions

GHG emissions from the energy sector can be divided into emissions from fuel combustion and fugitive emissions, mostly resulting from extraction and transportation activities. In 2017, CO_2 accounted for 65.5% of total GHG emissions in Uzbekistan's energy sector and CH_4 for 34.3%. CO_2 emissions are from fuel combustion and detailed in the section below, while CH_4 emissions are fugitive emissions from the natural gas sector.

Fugitive emissions in Uzbekistan are almost totally related to natural gas leaks, mainly from corroded pipelines and outdated equipment, especially valves. These emissions declined by 26% from 2010 to 2017 (from 66.6 Mt CO_2-eq to 49.8 Mt CO_2-eq), while natural gas use decreased by 13%. Several factors helped reduce the emissions, including elimination of leaks in the main pipelines; modernisation of gas production, processing and transportation; and improving system accounting and loss control. Fugitive emissions from oil and coal production are insignificant.

In general, there are large differences between fugitive emissions data based on measurement campaigns and scientific studies, and the emissions levels reported by official public bodies, such as to the UNFCCC. This mismatch exists at both global and national levels and for all sources of emissions. The larger the hydrocarbon producer, the larger the difference can be. For Uzbekistan, the available literature values place the fugitive methane emissions from energy sources anywhere from 5% to 80% lower than the official methane emissions from energy reported to the UNFCCC.

Figure 8.2 Energy-related GHG emissions in Uzbekistan by type, 1990-2017



Fugitive emissions, in essence natural gas leaks, provide more than one-third of Uzbekistan's energy-related GHG emissions.

* Includes fugitive CO_2, CH_4 and N_2O emissions from energy.
** Includes total GHG emissions (CO_2, CH_4 and N_2O) from fuel combustion.
Source: Uzhydromet (2022), First Biennial Update Report of the Republic of Uzbekistan under the UN Framework Convention on Climate Change.

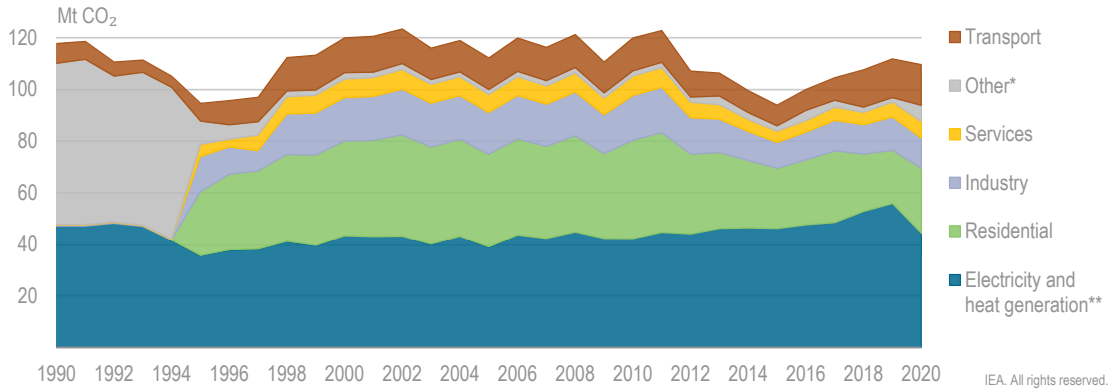
CO_2 emissions from fuel combustion

In 2019, Uzbekistan's CO_2 emissions from fuel combustion[12] amounted to 109.6 Mt CO_2. Power and heat generation accounted for 41% of the total, and households were the second-largest emitter (23%), followed by transport (14%) and industry (11%). Remaining emissions came from services (6%) and agriculture and energy industries (6%).

Although Uzbekistan's economy grew 151% on a per capita basis between 2000 and 2020, CO_2 emissions from fuel combustion decreased 9%.

Several measures have limited the growth in CO_2 emissions. For example, in power generation, power plant fleet renewal through CCGTs has improved efficiency. In transport, vehicle fleet renewal and the use of CNG as the main fuel have largely offset the impact of the increase in fleet size and transport activity on emissions. In agriculture, irrigation pumps have been replaced with efficient modern ones.

Figure 8.3 Uzbekistan's CO_2 emissions from fuel combustion by sector, 1990-2020

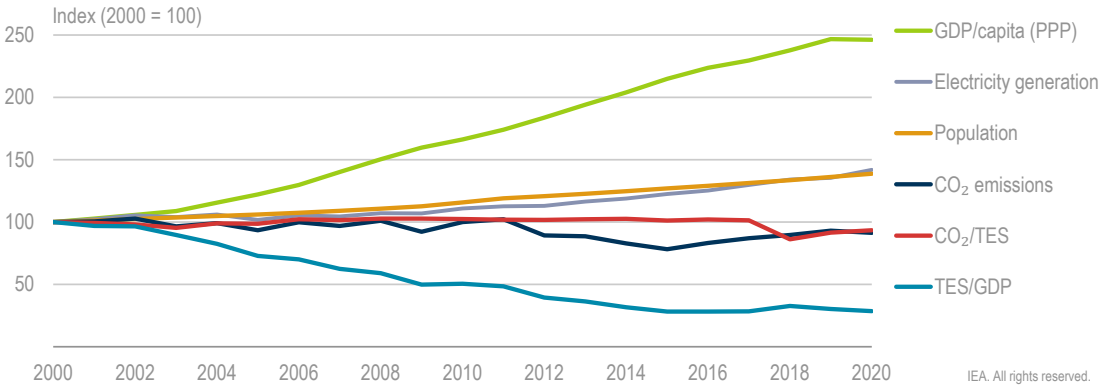


In recent years, around half of Uzbekistan's CO_2 emissions from fuel combustion have come from electricity and heat generation.

* Includes emissions from energy consumption in agriculture, fishing and unspecified sectors, for which the share is notable for 1990-1994.
** Includes emissions from electricity and heat generation, as well as energy industry own use.
Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

[12] CO_2 emissions from fuel combustion are estimated based on Uzbekistan's sectoral energy consumption data as reported by the IEA. These emissions estimates are around 10% higher than those derived from the national reporting (Uzhydromet, 2022). This is most likely because the IEA secretariat has estimated the energy consumption data for years with limited energy data availability. For more recent years, official data are more available, reducing the discrepancy. It is recommended for UzStat and Uzhydromet to continue to co-operate on energy statistics to maximise synergies.

Figure 8.4 Energy-related CO_2 emissions and main drivers in Uzbekistan, 2000-2020

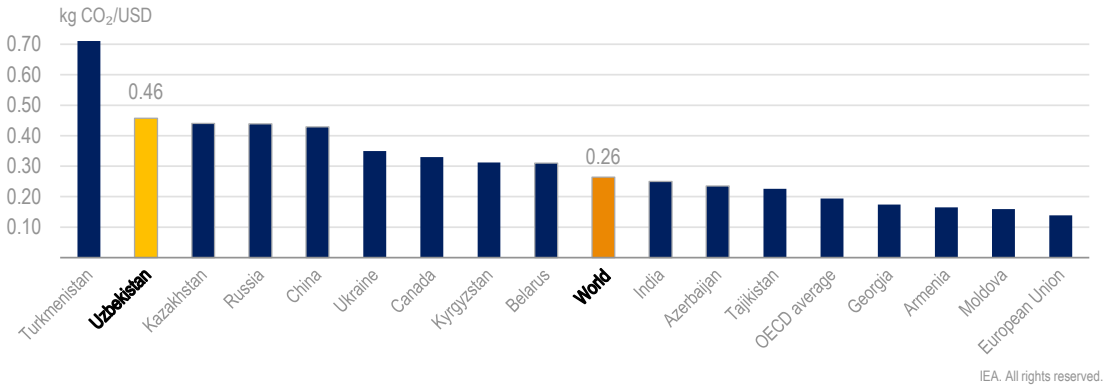


CO_2 emissions have effectively remained constant since 2000, despite fast economic and population growth in the same time period.

Note: GDP in constant USD 2015 prices and at PPP.
Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

A country's CO_2 emissions are partly determined by its population size and level of economic development, measured in terms of GDP per capita. Emissions are also affected by the energy intensity of the economy and the carbon intensity of its energy supply, both of which have declined significantly since 2000, thanks to modernisation across the economy, shutting down of inefficient industrial facilities and more efficient energy use in buildings, in part triggered by gas and electricity tariff increases since 2018.

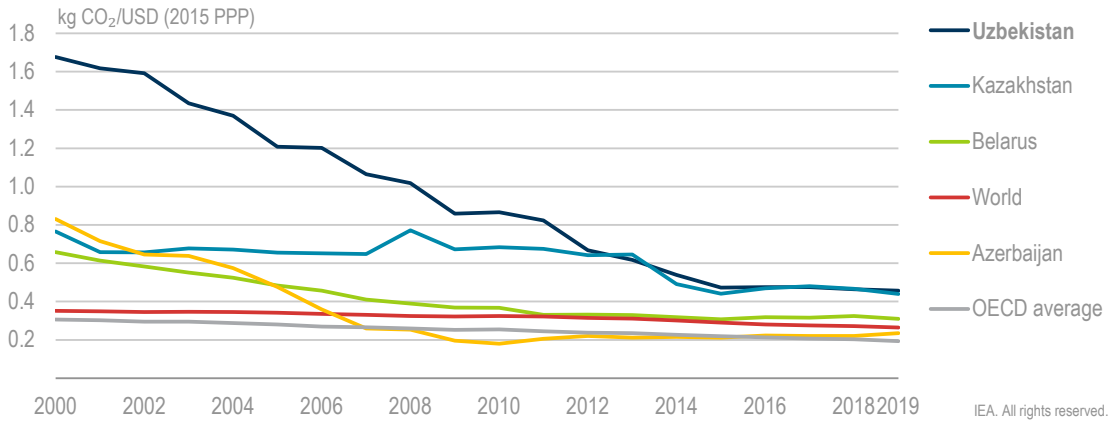
Figure 8.5 CO_2 intensity in Uzbekistan and selected countries, 2019



Uzbekistan's CO_2 intensity remains one of the highest in the world.

Note: Real GDP in USD 2015 prices and at PPP.
Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics.

Figure 8.6 CO_2 intensity in Uzbekistan and selected countries, 2000-2019

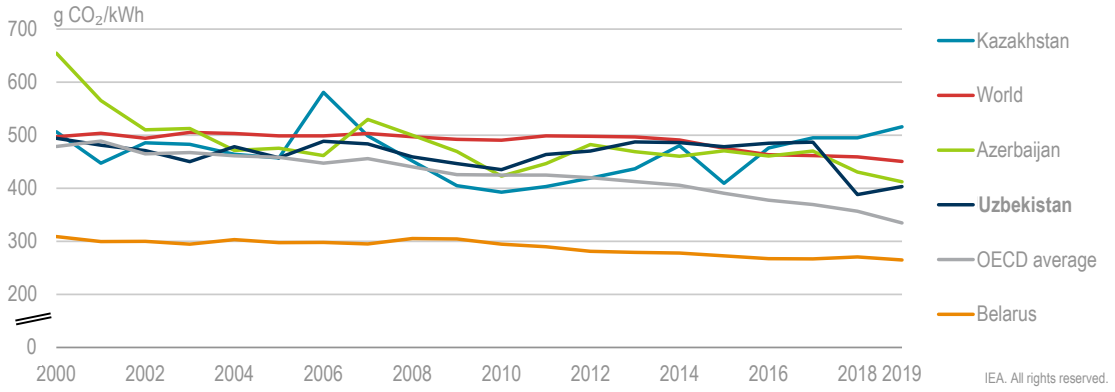


Despite an impressive decline since 2000, Uzbekistan's CO_2 intensity has plenty of room to decrease further.

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

Uzbekistan's CO_2 intensity fell by almost three-fourths from 2000 to 2020 – from 1.57 kg CO_2 per USD (at 2015 PPP) in 2000 to 0.42 kg in 2020. Despite this significant decrease, however, Uzbekistan's CO_2 intensity remains one of the highest in the world, 77% above the world average of 0.26 kg CO_2/USD (at 2015 PPP). Fossil fuels continue to dominate Uzbekistan's energy supply, and its energy-intensive industries and space heating are relatively inefficient.

Figure 8.7 CO_2 intensity of power and heat generation in Uzbekistan and selected countries, 2000-2019



Uzbekistan's specific emissions from electricity and heat generation have decreased 18% since 2000 and are 10% lower than the world average.

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

In 2019, Uzbekistan's power and heat generation emitted an average of 403 g CO_2/kWh). This is 18% less than in 2000, mainly thanks to power plant modernisation and a switch from oil to gas in the 2000s. Since 2000, Uzbekistan has managed to reduce this intensity two times faster than the world as a whole, and now its intensity is 10.5% lower than the world average of 450.4 g CO_2/kWh. Uzbekistan's power and heat sector CO_2 intensity is

set to decline further, as the country makes efforts to raise the share of renewable energy in electricity supply to 25% by 2030 from 10% in 2019.

Institutions

Several central government entities are involved in planning and implementing climate policy in Uzbekistan. The following are active on energy-related policies and measures:

The Centre of the Hydrometeorological Service of the Republic of Uzbekistan (Uzhydromet) is responsible for fulfilling the country's commitments under the UNFCCC and the Paris Agreement.

The Ministry of Investment and Foreign Trade is responsible for interaction with the UNFCCC Green Climate Fund and attracting investments for NDC implementation.

The Ministry of Economic Development and Poverty Reduction is responsible for the implementation of the Strategy of the Republic of Uzbekistan for Transition to a Green Economy.

The MoE, together with the Ministry of Economic Development and Poverty Reduction, is responsible for the development and implementation of the National Low-Carbon Development Strategy.

The Ministry of Innovative Development is responsible for the introduction of green economy technologies.

The Ministry of Transport implements the gradual transition of public transport to using natural gas and electricity and measures to expand the production and use of cleaner and greener vehicles.

The Ministry of Construction implements energy-efficient and energy-saving innovative solutions in the construction of buildings.

The Ministry of Finance develops financial mechanisms to support the "green" economy.

Targets and policies – updated NDC

Under the Paris Agreement, Uzbekistan pledged to reduce GHG emissions per unit of GDP by 35% from 2010 to 2030. Uzbekistan’s initial NDC, from 2018, was to decrease the carbon intensity of the economy by 10% from 2010 to 2030.

Uzbekistan has decided so far not to set an absolute emissions reduction target. The government expects that rapid population growth and economic development, including in construction, textiles, automotive industry and agriculture, will require more energy. In addition, the further aridification of the country’s climate will require additional energy consumption for cooling. Therefore, it estimates that GHG emissions will increase to 2030, although insignificantly. The updated NDC does not quantify this increase, however (Uzbekistan, GoU, 2021). The most recent publicly available official GHG emissions projections date from 2016.

The updated NDC lists the following policies and measures to meet the 2030 pledge:

- increasing the share of renewable energy in power generation to 25% by constructing solar, wind and small hydropower plants (in total, around 10 GW of new generating capacity)
- introducing more energy-saving technologies in industry and construction; agriculture; power generation, transmission and distribution; gas production and transportation as well as in other sectors of the economy
- introducing alternative fuels in transportation
- improving productivity of agricultural land
- improving solid waste management
- improving water management
- expanding forest areas
- introducing effective incentives for resource mobilisation
- other measures and actions reflected in the Strategy for Transition to a Green Economy until 2030, which is currently under revision and is to be extended until 2050.

The updated NDC names introducing an integrated monitoring, reporting and verification (MRV) system a priority. The system would help to track the implementation of Uzbekistan's quantitative obligations under the Paris Agreement. . It would cover GHG emissions, mitigation actions, adaptation actions, and financial and technological support required and received.

Carbon pricing instruments can be very useful to ensure that climate targets are achieved efficiently and at the lowest cost. The updated NDC says that Uzbekistan is considering the possibility of introducing a carbon tax across all emitting sectors.

Meeting the 2030 climate target is supported by the following two major strategies:

1. Action Strategy on Five Priority Areas for Development of the Republic of Uzbekistan in 2017-2021 (UP-4947 dated 07 February 2017) focuses on reducing the energy and resource intensity of the economy, widespread introduction of energy-saving technologies in production, increased use of renewable energy, and the adoption of systemic measures to mitigate the adverse impact of global climate change and of the drying up of the Aral Sea on agriculture development and livelihood of the population.
2. The Green Economy Transition Strategy 2019-2030 (Presidential Decree No. 4477 dated 4 October 2019) aims to achieve sustainable economic progress by integrating green economy principles into the ongoing structural reforms. Its priorities are:

- energy efficiency improvements in the key sectors of the economy
- diversification of energy consumption and the use of renewable energy sources
- climate change adaptation and mitigation and improved use of natural resources and conservation of natural ecosystems
- development of financial and non-financial mechanisms to support the green economy.

The strategy is currently under revision and is to be extended until 2050, taking into account Uzbekistan's increased NDC ambitions and the need to decarbonise the economy.

Uzbekistan is yet to develop a long-term low GHG emissions development strategy to mid-century, an obligation under the Paris Agreement. Together with the EBRD, it has, however, prepared a *Roadmap to Carbon Neutral Electricity Sector in Uzbekistan by 2050*. The main idea would be to diversify the energy sources for electricity away from coal and gas (MoE, 2021).

The roadmap suggests several actions under the following five pillars: 1) electricity infrastructure transformation; 2) a regulatory framework to allow for renewable energy penetration; 3) subsidy reform and a carbon price mechanism; 4) campaigns to generate public support; and 5) environmental protection. These specific actions may include:

- Large-scale deployment of clean energy resources as well as replacing inefficient old coal and gas power plants with low-carbon and gas-efficient modern technologies.
- Reducing the gas value chain's carbon footprint (gas flaring and venting).
- Using gas with carbon capture and storage to produce hydrogen for commercial production of low-/zero-carbon fuels and transitioning to green hydrogen in the long run.
- Leveraging private sector know-how, knowledge, technology and financing in the electricity and gas sectors.

Climate change adaptation

Uzbekistan is one of the countries most vulnerable to climate change. Since the early 1950s, air temperature in Uzbekistan has increased by 0.29°C on average every ten years, twice the global average. The country may face more droughts, water shortages, increased desertification and land degradation (Uzbekistan, GoU, 2021).

The most affected sectors of the economy are expected to be agriculture, water supply and forestry. Agriculture is both key for food security of the country's growing population and a major export sector. The higher temperatures and droughts are also contributing to the continuing drying up of the Aral Sea, which has already lost 57% of its area and 80% of its volume in the last four decades. Large parts of the Aral Sea have turned into a salt desert called Aralkum, and its polluted salty dust adversely affects the ecology of the entire country (Uzbekistan, GoU, 2021).

In the energy sector, climate change may limit Uzbekistan's capacity to generate hydropower, especially in summer and autumn when energy demand for cooling could be higher. Future hydropower potential will also depend on the development and adaptation plans of its upstream neighbours, such as Tajikistan, as well as energy sector reforms to create enabling environments. Around 80% of Uzbekistan's water supplies come from resources originating outside the country (World Bank and ADB, 2021).

The government is developing a climate change adaptation plan, with UNDP support. The national allocation plan preparation aims to strengthen co-ordination for intersectoral adaptation planning and implementation of adaptation measures and actions, strengthen statistical database and priority adaptation planning and budgeting options at national and regional levels, and develop adaptation financing and an investment strategy. Priority economic sectors selected for adaptation are agriculture, water resources, health care, housing and emergency management (Uzbekistan, GoU, 2021).

The adaptation plan will build on several existing key documents, including the Agriculture Development Strategy 2020-2030, the Green Economy Transition Strategy for 2019-2030 and the State Programmes for the Development of the Aral Sea Region (2017-2021).

Assessment

In its energy policy, the government prioritises security of supply and energy affordability for the growing population over climate concerns. Energy use per capita is low, but GHG emissions per capita are only slightly below the world average. The economy remains very carbon-intensive. Although Uzbekistan's carbon intensity fell by almost three-fourths from 2000 to 2020, it is still one of the highest in the world. This is mainly due to the large share of use fossil fuels in its energy supply, and to its high proportion of relatively inefficient energy-intensive industries and space heating.

Around three-quarters of Uzbekistan's total GHG emissions are energy-related, and many options are available to reduce emissions in the energy sector. To be politically acceptable, climate policies and measures should support Uzbekistan's higher-priority energy policy goals. Limiting emissions and switching to cleaner fuels will also help reduce local air pollution (for local air pollution information, see UNECE, 2020).

Under the Paris Agreement, Uzbekistan has pledged to reduce GHG emissions per unit of GDP by 35% from 2010 to 2030. The IEA recognises this increase in ambition from Uzbekistan's initial NDC, from 2018, which was to decrease the carbon intensity of the economy by 10% from 2010 to 2030.

Uzbekistan has so far not adopted an absolute target for GHG emissions, because of its projected fast population growth and the need for economic growth. The government published official GHG projections most recently in 2016. In the updated NDC, it expects GHG emissions to grow to 2030, albeit insignificantly. Uzbekistan's updated NDC will need the support of monitoring and enforcement actions, as well as schemes, financial incentives and resources to manage changes that result from implementation. As a priority, the government should develop and adopt an integrated MRV system to track the implementation.

The role of each emission source in achieving the 2030 target needs to be clarified. In addition, energy and climate goals in sectoral plans (power and heat generation, oil and gas, coal) need to be co-ordinated to ensure coherence and consistency. For example, the government has plans to increase domestic coal production and double electricity generation capacity.

The IEA encourages the government also to develop a long-term low-GHG-emission development strategy. This strategy can build on the current *Roadmap to Carbon Neutral Electricity Sector in Uzbekistan by 2050*. In addition, the government should finalise work on developing a climate change adaptation plan.

The single largest source of GHGs are methane leaks from the natural gas system. Mitigating these emissions has been successful, and from 2010 to 2017, fugitive emissions from the gas system declined two times faster than natural gas use. Globally, preventing fugitive emissions often comes at no net cost, because the value of the captured gas exceeds the cost of the abatement measures (IEA, 2021). In addition to preventing gas

leaks, Uzbekistan has also managed to reduce gas flaring and venting to around 1 bcm per year (see the chapter on natural gas).

Several measures have also already limited the growth in CO_2 emissions. For example, power plant fleet renewal through CCGTs, vehicle fleet renewal and the use of CNG as the main fuel in transport and, in agriculture, replacing irrigation pumps with efficient modern ones.

Uzbekistan has ample scope to be more ambitious in its climate policy, and progress requires simultaneous action on several fronts. The increasing GHG emissions in industry, construction and transport underline the need for further efforts to reduce emissions in those sectors. For significant energy efficiency gains, end-user tariffs should be reformed and MEPS introduced.

Work to reduce fugitive emissions should continue. The government's policy to direct natural gas use to petrochemicals production and encourage the construction of several gigawatts of renewable energy and nuclear generating capacity will help to reduce CO_2 emissions.

As international rules for carbon offsets become clearer, the government should also consider how to best attract international carbon financing to help modernise its power and heat generation and heavy industry sectors, for example. Uzbekistan has already had positive experiences of several successful Clean Development Mechanism projects.

Considerining carbon pricing

The updated NDC states that Uzbekistan may introduce a carbon tax. The IEA encourages the government to consider overall objectives of carbon pricing, and the broader price signals acting on energy use and production. Carbon pricing measures, whether emissions trading or taxes, should ideally be coherent with measures to phase out fossil fuel subsidies (which undermine the aims of carbon pricing) and to establish adequate and economically justified energy prices and tariffs. The overall price signals on energy, and the impacts on final prices for users, will be important for aligning investments and activities. Effective carbon taxation should, however, be phased in gradually and be predictable and transparent to encourage long-term investment and allow businesses to take the tax into account in their planning. As all fiscal measures, it should also be supplemented by measures to address the policy's income effect. For instance, carbon taxes can be designed to be fully or partly revenue-neutral, and some of the revenues raised could be used in carefully targeted ways to minimise their negative impacts – for example to fund cash transfers to poorer households and to support industrial energy efficiency measures.

Limiting emissions from transport

In many emerging economies, transport is a fast-growing source of emissions. It will require special attention in Uzbekistan as well. Uzbekistan's car ownership rate is still low, around 100 cars per 1 000 inhabitants, one-fifth of the EU level, for example (see Chapter 7, Energy efficiency). As Uzbekistan's economy grows and the citizens become wealthier, emissions from transport are set to rise.

Natural gas is the main fuel in Uzbekistan's transport sector, which limits emissions compared with oil-dominated transport systems. Also, the country's refineries are being modernised to produce Euro-5 quality fuels, which over time will lead to a cleaner transport sector.

Significant improvements in vehicle emissions could be achieved by ensuring incentives encourage the use of the highest-quality fuels, for example through reducing access to lower-quality fuels, changing the approach to price regulation across all fuels and banning certain vehicles in urban areas. Expanding the supply of public transport and developing rail infrastructure should also help. Today, road transport is by far the dominant transport mode, accounting for 96% of passenger transport and 88% of freight transport in 2018. Public transport has significant room to grow. The government should intensify efforts to improve access to public transport, expand the networks to key residential areas and increase the attractiveness of service by encouraging vehicle fleet modernisation, for example (UNECE, 2020).

Recommendations

The government of Uzbekistan should:

- Introduce a system for measuring, reporting and verifying GHG emissions.
- Improve co-ordination between sectoral energy plans and climate targets to enable the country to meet its 2030 NDC, for example by adopting an NDC implementation roadmap that can coordinate policy action across ministries.
- Consider where a carbon price signal may encourage GHG reductions within or across the economy to design and implement carbon pricing in a manner that supports overall policy objectives.
- Intensify efforts to reduce emissions, in particular from the fossil fuel industry (methane leaks, gas flaring), power and heat generation and space heating, and limit their growth, in particular in the transport sector .
- As part of developing a national adaptation plan, assess the impacts of climate change on the energy sector, and follow-up with an adaptation plan specific to the energy sector to be used in future energy sector development plans.

References

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

IEA (2021), Curtailing Methane Emissions from Fossil Fuel Operations, https://www.iea.org/reports/curtailing-methane-emissions-from-fossil-fuel-operations.

UNECE (United Nations Economic Commission for Europe) (2020), Environmental Performance Reviews: Uzbekistan, Environmental Performance Reviews Series No. 52, https://unece.org/environment-policy/publications/3rd-environmental-performance-review-uzbekistan.

Uzbekistan, GoU (Government of Uzbekistan) (2021), Updated Nationally Determined Contribution of the Republic of Uzbekistan, https://unfccc.int/sites/default/files/NDC/2022-06/Uzbekistan_Updated%20NDC_2021_RU.pdf.

Uzbekistan, MoE (Ministry of Energy) (2021), A carbon neutral electricity sector in Uzbekistan: Summary for policymakers, https://minenergy.uz/uploads/57c6df8d-6ec0-8362-504a-fb3162895df6_media_.pdf.

Uzhydromet (2021), *First Biennial Update Report of the Republic of Uzbekistan under the UN Framework Convention on Climate Change,* https://unfccc.int/sites/default/files/resource/FBURUZeng.pdf.

World Bank and ADB (Asian Development Bank) (2021), Climate risk country profile: Uzbekistan, https://climateknowledgeportal.worldbank.org/sites/default/files/2021-06/15838-Uzbekistan%20Country%20Profile-WEB.pdf.

ANNEX A: Organisation of the review

Review criteria

The Shared Goals, which were adopted by the International Energy Agency (IEA) Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

Review team and preparation of the report

The IEA IDR team visited Tashkent 11-15 April 2022. The team met with government officials, energy suppliers, interest groups and various other organisations.

This report was drafted on the basis of these meetings, the team's preliminary assessment of the country's energy policy, the government response to the IEA energy policy questionnaire and other information.

The members of the team were:

IEA member countries

- Regula PETERSEN, Renewable Energy Specialist, Swiss Federal Office of Energy, SWITZERLAND

EU4Energy countries

- Firdausi ASMATBEKOV, Head of Trade and Services Statistics Department, Statistical Agency under the President of the Republic, TAJIKISTAN
- Gulmira KARAULOVA, Director, Department of Services and Energy Statistics, Bureau of National Statistics of the Agency for Strategic Planning and Reforms, KAZAKHSTAN
- Abulfaz KARIMOV, Deputy Head of the Department of Energy and Environment Statistics of the State Statistical Committee, AZERBAIJAN
- Elchin TARGULUYEV, Senior Advisor, Power and Energy Efficiency Department, Ministry of Energy, AZERBAIJAN
- Jamshed VAZIROV, Advisor to the Ministry of Energy and Water Resources, TAJIKISTAN
- Tolkyn YESSENGELDINA, Deputy Director, Department of International Cooperation, Ministry of Energy, KAZAKHSTAN

IEA for EU4Energy programme

- Connor ENRIGHT, Consultant, Energy Efficiency Expert
- Markus FAGER-PINTILÄ, Statistics Programme Manager
- Aiymgul KERIMRAY, Country Expert for Kazakhstan
- Andrej MALOCHKA, Consultant, Power and District Heat Sectors Expert
- Zaur MAMMADOV, Country Expert for Azerbaijan

- Murman MARGVELASHVILI, Country Expert for Georgia (Team Leader)
- Armin MAYER, Consultant, Energy Efficiency Expert
- Tolib SULTANOV, Country Expert for Uzbekistan
- Miika TOMMILA, Consultant, Key Author of the IDR
- Furugzod USMONOV, Country Expert for Tajikistan

The team is grateful for the co-operation and assistance of the many people it met throughout the visit. Thanks to their knowledge, openness and willingness to share information, the interviews were highly informative and productive. The team expresses its gratitude to Farrukh Khalimov, Chief Specialist of the Foreign Economic Relations Department, and to Sarvar Kamalov, Leading Specialist of the Foreign Economic Relations Department, Ministry of Energy of Uzbekistan, and to the State Committee on of the Republic of Uzbekistan on Statistics, namely to its Chairman Bakhodir Begalov, to the Deputy Chairman Agzam Ikramov, and to the Head of Industry Statistics Department, Sardor Jurayev for co-ordinating the response to the IEA energy policy questionnaire and for supporting the team visit. The team also expresses its sincere thanks to Tolib Sultanov, Country Expert for Uzbekistan for the IEA for EU4Energy programme, for his immense personal commitment to the review, and for organisation and coordination efforts that he made to make this review possible.

Miika Tommila was the lead author of the report and drafted Chapters 1-4 and 8. Andrej Malochka was the lead author of Chapter 5, Armin Mayer and Connor Enright of Chapter 7, and Murman Margvelashvili of Chapter 6. Markus Fager-Pintilä prepared the graphs and drafted the sections related to statistics and energy data. Anna Petrus organised and co-ordinated the review process.

The review team also would like to thank Rebecca Gaghen, Head of the Europe, Middle East, Africa and Latin America Division for investing her time in reading the report and providing comments. Helpful comments and updates were provided by the review team members and IEA staff, including: Carlos Fernández Alvarez, Kazuhiro Kurumi, Sara Moarif, Gergely Molnar, and Talya Vatman. Therese Walsh managed the editing process and Erin Crum edited the report. Astrid Dumond managed the production process, Isabelle Nonain-Semelin finalised the layout, and Taline Shahinian and Allison Leacu prepared the maps and images.

Organisations visited

Agency for the Development of Nuclear Energy under the Ministry of Energy of the Republic of Uzbekistan (Uzatom)

Asian Development Bank (ADB)

Central Asian Regional Coordination and Dispatch Centre “Energia”

EU Delegation to Uzbekistan

Green Business Innovation LLC

Institute of Physics and Technology "Physics-Sun" of the Academy of Sciences

Ministry of Construction

Ministry of Economic Development and Poverty Reduction

Ministry of Energy

Ministry of Finance

Ministry of Housing and Communal Services

Ministry of Innovative Development

Ministry of Investment and Foreign Trade

Ministry of Transport

National Electric Grid of Uzbekistan JSC

National Research Institute for Renewable Energy Sources under the Ministry of Energy

Oliy Majlis (Parliament of Uzbekistan)

Regional Electric Networks JSC

State Committee on Statistics (UzStat)

Tashkent State Technical University

Thermal Power Plants JSC

United Nations Development Programme (UNDP)

United States Agency for International Development (USAID)

Uzbekhydroenergo

Uzbekneftgaz JSC

Uzbekugol JSC

Uztransgaz JSC

World Bank

ANNEX B: Energy balances and key statistical data

Uzbekistan

Energy balances and key statistical data

Unit: Mtoe

SUPPLY		1990	2000	2010	2017	2018	2019	2020
TOTAL PRODUCTION		**38.66**	**50.19**	**54.43**	**46.42**	**55.17**	**54.47**	**45.24**
Coal		2.26	0.88	1.27	1.43	1.48	1.44	1.47
Peat		-	-	-	-	-	-	-
Oil		2.81	7.77	4.24	2.91	3.04	3.16	2.92
Natural gas		33.01	41.22	48.21	41.40	50.14	49.31	40.42
Biofuels and waste[1]		-	-	-	-	-	-	-
Nuclear		-	-	-	-	-	-	-
Hydro		0.57	0.30	0.70	0.68	0.51	0.56	0.43
Wind		-	-	-	-	-	-	-
Geothermal		-	-	-	-	-	-	-
Solar/other		-	-	-	-	-	-	-
TOTAL NET IMPORTS		**8.74**	**-4.23**	**-9.05**	**-6.38**	**-8.44**	**-8.56**	**0.21**
Coal	Exports	0.24	-	0.00	-	-	-	-
	Imports	1.36	0.01	0.00	0.32	0.51	0.56	1.13
	Net imports	1.13	0.01	0.00	0.32	0.51	0.56	1.13
Oil	Exports	0.88	0.53	0.17	0.10	0.10	0.05	0.04
	Imports	9.19	0.01	0.70	1.08	1.30	0.88	1.50
	Int'l marine and aviation bunkers	-	-	-	-0.14	-0.18	-0.14	-0.11
	Net imports	8.32	-0.52	0.53	0.84	1.02	0.70	1.35
Natural gas	Exports	2.31	5.01	9.50	7.48	9.93	9.93	2.48
	Imports	1.79	1.18	0.02	-	-	-	-
	Net imports	-0.52	-3.83	-9.48	-7.48	-9.93	-9.93	-2.48
Electricity	Exports	1.60	1.10	0.66	0.65	0.23	0.18	0.23
	Imports	1.42	1.21	0.56	0.60	0.19	0.29	0.45
	Net imports	-0.19	0.11	-0.10	-0.05	-0.03	0.11	0.22
TOTAL STOCK CHANGES		**-0.01**	**0.31**	**-0.25**	**-0.33**	**1.38**	**1.16**	**-0.20**
TOTAL SUPPLY (TES)[2]		**47.39**	**46.27**	**45.13**	**39.71**	**48.11**	**47.07**	**45.25**
Coal		3.39	1.12	0.93	1.69	2.44	2.09	2.91
Peat		-	-	-	-	-	-	-
Oil		11.13	7.25	5.01	3.73	3.98	3.94	4.30
Natural gas		32.49	37.49	38.59	33.67	41.21	40.37	37.41
Biofuels and waste[1]		-	-	-	-	-	-	-
Nuclear		-	-	-	-	-	-	-
Hydro		0.57	0.30	0.70	0.68	0.51	0.56	0.43
Wind		-	-	-	-	-	-	-
Geothermal		-	-	-	-	-	-	-
Solar/other		-	-	-	-	-	-	-
Electricity trade[3]		-0.19	0.11	-0.10	-0.05	-0.03	0.11	0.22
Shares in TES (%)								
Coal		*7.1*	*2.4*	*2.1*	*4.2*	*5.1*	*4.4*	*6.4*
Peat		-	-	-	-	-	-	-
Oil		*23.5*	*15.7*	*11.1*	*9.4*	*8.3*	*8.4*	*9.5*
Natural gas		*68.6*	*81.0*	*85.5*	*84.8*	*85.7*	*85.8*	*82.7*
Biofuels and waste[1]		-	-	-	-	-	-	-
Nuclear		-	-	-	-	-	-	-
Hydro		*1.2*	*0.7*	*1.6*	*1.7*	*1.1*	*1.2*	*0.9*
Wind		-	-	-	-	-	-	-
Geothermal		-	-	-	-	-	-	-
Solar/other		-	-	-	-	-	-	-
Electricity trade[3]		*-0.4*	*0.2*	*-0.2*	*-0.1*	*-0.1*	*0.2*	*0.5*

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1990**	**2000**	**2010**	**2017**	**2018**	**2019**	**2020**
TFC	**35.77**	**37.94**	**38.35**	**29.51**	**29.42**	**30.00**	**33.07**
Coal	1.27	0.26	0.28	0.54	0.89	0.77	1.30
Peat	-	-	-	-	-	-	-
Oil	8.33	4.97	3.90	3.37	3.56	3.58	3.93
Natural gas	19.68	26.70	28.12	19.08	17.64	18.23	20.68
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
Electricity	3.69	3.48	3.22	3.88	4.60	4.56	4.47
Heat	2.80	2.53	2.83	2.64	2.72	2.86	2.68
Shares in TFC (%)							
Coal	*3.5*	*0.7*	*0.7*	*1.8*	*3.0*	*2.6*	*3.9*
Peat	-	-	-	-	-	-	-
Oil	*23.3*	*13.1*	*10.2*	*11.4*	*12.1*	*11.9*	*11.9*
Natural gas	*55.0*	*70.4*	*73.3*	*64.7*	*60.0*	*60.8*	*62.6*
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
Electricity	*10.3*	*9.2*	*8.4*	*13.1*	*15.6*	*15.2*	*13.5*
Heat	*7.8*	*6.7*	*7.4*	*9.0*	*9.3*	*9.5*	*8.1*
TOTAL INDUSTRY[4]	**4.39**	**9.50**	**9.34**	**7.19**	**6.80**	**7.37**	**6.94**
Coal	-	0.06	0.05	0.05	0.09	0.27	0.23
Peat	-	-	-	-	-	-	-
Oil	2.06	0.95	0.53	0.41	0.40	0.30	0.29
Natural gas	-	6.74	7.10	4.82	4.53	4.88	4.32
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
Electricity	1.87	1.33	1.19	1.49	1.33	1.49	1.70
Heat	0.45	0.41	0.46	0.43	0.44	0.43	0.40
Shares in total industry (%)							
Coal	-	*0.6*	*0.6*	*0.6*	*1.3*	*3.7*	*3.3*
Peat	-	-	-	-	-	-	-
Oil	*47.0*	*10.0*	*5.7*	*5.6*	*5.9*	*4.0*	*4.2*
Natural gas	-	*71.0*	*76.0*	*67.0*	*66.7*	*66.1*	*62.3*
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
Electricity	*42.7*	*14.0*	*12.8*	*20.8*	*19.5*	*20.3*	*24.4*
Heat	*10.4*	*4.3*	*4.9*	*6.0*	*6.5*	*5.8*	*5.8*
TRANSPORT	**2.75**	**4.96**	**4.72**	**3.28**	**5.61**	**5.93**	**6.03**
OTHER[5]	**28.63**	**23.49**	**24.30**	**19.04**	**17.01**	**16.70**	**20.10**
Coal	1.27	0.20	0.23	0.49	0.80	0.50	1.07
Peat	-	-	-	-	-	-	-
Oil	3.62	0.66	0.32	0.85	0.53	0.82	0.69
Natural gas	19.68	18.48	19.46	13.20	10.25	10.06	13.37
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
Electricity	1.71	2.03	1.92	2.28	3.15	2.88	2.68
Heat	2.34	2.12	2.37	2.21	2.28	2.43	2.28
Shares in other (%)							
Coal	*4.4*	*0.8*	*0.9*	*2.6*	*4.7*	*3.0*	*5.3*
Peat	-	-	-	-	-	-	-
Oil	*12.6*	*2.8*	*1.3*	*4.5*	*3.1*	*4.9*	*3.5*
Natural gas	*68.8*	*78.7*	*80.1*	*69.4*	*60.3*	*60.2*	*66.5*
Biofuels and waste[1]	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
Electricity	*6.0*	*8.7*	*7.9*	*12.0*	*18.5*	*17.3*	*13.3*
Heat	*8.2*	*9.0*	*9.8*	*11.6*	*13.4*	*14.6*	*11.3*

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1990**	**2000**	**2010**	**2017**	**2018**	**2019**	**2020**
ELECTRICITY GENERATION[6]							
Input (Mtoe)	13.66	12.59	12.90	16.19	12.31	13.07	12.83
Output (Mtoe)	4.84	4.03	4.47	5.23	5.41	5.46	5.72
Output (TWh)	56.33	46.86	51.98	60.82	62.90	63.53	66.50
Output Shares (%)							
Coal	*7.4*	*4.1*	*4.1*	*3.4*	*3.4*	*3.7*	*4.0*
Peat	-	-	-	-	-	-	-
Oil	*4.4*	*10.0*	*1.5*	*0.3*	*0.7*	*1.1*	*0.7*
Natural gas	*76.4*	*78.3*	*78.7*	*83.3*	*86.5*	*85.0*	*87.8*
Biofuels and waste[1]	-	-	-	-	-	-	-
Nuclear	-	-	-	-	-	-	-
Hydro	*11.8*	*7.5*	*15.8*	*13.0*	*9.4*	*10.2*	*7.5*
Wind	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
TOTAL LOSSES	**11.62**	**13.89**	**14.30**	**15.22**	**16.21**	**16.92**	**12.11**
of which:							
Electricity and heat generation[7]	8.82	8.55	8.43	10.96	6.90	7.60	7.11
Other transformation	0.15	0.38	0.59	0.11	0.11	0.11	0.15
Own use and transmission/distribution losses	2.66	4.96	5.28	4.15	9.19	9.21	4.85
Statistical differences	**-**	**5.56**	**7.52**	**5.01**	**-2.49**	**-0.14**	**-0.08**
INDICATORS	**1990**	**2000**	**2010**	**2017**	**2018**	**2019**	**2020**
GDP (billion 2015 USD)	24.50	31.58	60.88	95.32	100.43	106.16	108.00
Population (millions)	20.51	24.65	28.56	32.39	32.96	33.58	34.23
TES/GDP (toe/1000 USD)[8]	1.93	1.47	0.74	0.42	0.48	0.44	0.42
Energy production/TES	0.82	1.08	1.21	1.17	1.15	1.16	1.00
Per capita TES (toe/capita)	2.31	1.88	1.58	1.23	1.46	1.40	1.32
Oil supply/GDP (toe/1000 USD)[8]	0.45	0.23	0.08	0.04	0.04	0.04	0.04
TFC/GDP (toe/1000 USD)[8]	1.46	1.20	0.63	0.31	0.29	0.28	0.31
Per capita TFC (toe/capita)	1.74	1.54	1.34	0.91	0.89	0.89	0.97
CO_2 emissions from fuel combustion ($MtCO_2$)[9]	117.8	120.0	119.9	104.5	107.6	111.8	109.6
CO_2 emissions from bunkers ($MtCO_2$)[9]	-	-	-	0.4	0.5	0.4	0.3
GROWTH RATES (% per year)	**90-00**	**00-10**	**10-17**	**17-18**	**18-19**	**19-20**	**00-20**
TES	-0.2	-0.2	-1.8	21.1	-2.2	-3.8	-0.1
Coal	-10.5	-1.8	8.9	44.9	-14.6	39.2	4.9
Peat	-	-	-	-	-	-	-
Oil	-4.2	-3.6	-4.1	6.8	-1.1	9.1	-2.6
Natural gas	1.4	0.3	-1.9	22.4	-2.0	-7.3	-0.0
Biofuels and waste[1]	-	-	-	-	-	-	-
Nuclear	-	-	-	-	-	-	-
Hydro	-6.1	8.8	-0.5	-25.6	9.6	-22.6	1.8
Wind	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-
Solar/other	-	-	-	-	-	-	-
TFC	0.6	0.1	-3.7	-0.3	2.0	10.2	-0.7
Electricity consumption	-0.6	-0.8	2.7	18.5	-0.9	-2.0	1.3
Energy production	2.6	0.8	-2.2	18.9	-1.3	-16.9	-0.5
Net oil imports	-	-	6.7	22.0	-31.5	92.9	-
GDP	2.6	6.8	6.6	5.4	5.7	1.7	6.3
TES/GDP	-2.7	-6.6	-7.9	15.0	-7.5	-5.5	-6.1
TFC/GDP	-1.9	-6.3	-9.7	-5.4	-3.5	8.3	-6.6

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Notes

1. Data on consumption of (solid) biofuels is not systematically collected in Uzbekistan.
2. Excludes international marine bunkers and international aviation bunkers.
3. Total supply of electricity represents net trade. A negative number in the share of TES indicates that exports are greater than imports.
4. Industry includes non-energy use.
5. Other includes residential, commercial and public services, agriculture/forestry, fishing, and other non-specified.
6. Inputs to electricity generation include inputs to electricity, co-generation and heat plants. Output refers only to electricity generation.
7. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil fuel electricity generation, theoretical losses are shown based on plant efficiencies of 100% for hydro, wind and solar photovoltaic.
8. Tonnes of oil equivalent per thousand US dollars at 2015 prices and exchange rates.
9. "CO_2 emissions from fuel combustion" have been estimated using the Intergovernmental Panel on Climate Change (IPCC) Tier I Sectoral Approach methodology from the 2006 IPCC Guidelines. Emissions from international marine and aviation bunkers are not included in national totals.

ANNEX C: International Energy Agency Shared Goals

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 in Paris, France.)

* Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

ANNEX D: Glossary and list of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

ADB	Asian Development Bank
CAPS	Central Asian Power System
CAREC	Central Asia Regional Economic Cooperation
CCGT	combined-cycle gas turbine
CDC	Coordinating Dispatch Center
CH_4	methane
CNG	compressed natural gas
CNPC	China National Petroleum Corporation
CO_2-eq	carbon dioxide equivalent
CO_2	carbon dioxide
CSP	concentrating solar power
DH	district heating
DHC	district heating and cooling
DNI	direct normal irradiance
DSO	distribution system operator
EBITDA	earnings before interest, taxes, depreciation and amortisation
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
EPC	energy performance certificate
ESCO	energy service company
EU	European Union
FDI	foreign direct investment
GDP	gross domestic product
GHG	greenhouse gas
GHI	global horizontal irradiance
GTL	gas-to-liquids
HPP	hydropower plant
IDR	in-depth review
IEA	International Energy Agency
IFC	International Finance Corporation
IFI	international financial institution
IMF	International Monetary Fund

IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
JODI	Joint Organisations Data Initiative
JSC	joint-stock company
JV	joint venture
KNOC	Korea National Oil Corporation
LED	light-emitting diode
LPG	liquefied petroleum gas
LULUCF	land-use, land-use change and forestry
MEPS	minimum energy performance standards
MHKO	Ministry of Housing and Communal Services
MMC	Mining and Metallurgy Combine
MoE	Ministry of Energy
MRV	monitoring, reporting and verification
N_2O	nitrous oxide
NDC	Nationally Determined Contribution
NGL	natural gas liquid
OECD	Organisation for Economic Co-operation and Development
PPA	power purchase agreement
PPP	purchasing power parity
PPPs	public-private partnerships
PSA	production sharing agreement
PV	photovoltaic
RES	renewable energy sources
RSA	risk service agreement
SAIDI	system average interruption duration index
SAIFI	system average interruption frequency index
SAMA	State Assets Management Agency
SCADA	supervisory control and data acquisition
SOE	state-owned enterprise
TES	total energy supply
TFC	total final energy consumption
TPP	thermal power plant
TSO	transmission system operator
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
UZS	Uzbekistan som
UzStat	State Committee of the Republic of Uzbekistan on Statistics
VAT	value-added tax
VRE	variable renewable energy

Units of measure

bcm	billion cubic metres
g	gramme
Gt	billion tonnes
GW	gigawatt
kb/d	thousand barrels per day
kg	kilogramme
km	kilometre
kt	kilotonne
ktpa	kilotonne per annum
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt
kWh	kilowatt-hours
L	litre
m	metre
m^2	square metre
m^3	cubic metre
mcm	million cubic metre
MJ	megajoule
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
MVA	megavolt amperes
MW	megawatt
MWh	megawatt-hour
t	tonne
toe	tonne of oil equivalent
TWh	terawatt-hour
W	watt

This publication has been produced with the financial assistance of the European Union and is part of the EU4Energy programme. This publication reflects the views of the International Energy Agency (IEA) Secretariat but does not necessarily reflect those of individual IEA member countries or the European Union. The IEA makes no representation or warranty, express or implied, in respect to the publication's contents (including its completeness or accuracy) and shall not be responsible for any use of, or reliance on, the publication.

EU4Energy is a collaboration between the IEA, the European Union, Focus Countries and other implementing parties, designed to support the aspirations of Focus Countries to implement sustainable energy policies and foster co-operative energy sector development at the regional level.

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

IEA Publications
International Energy Agency
Website: www.iea.org
Contact information: www.iea.org/about/contact

Typeset in France by IEA - June 2022
Cover design: IEA

Uzbekistan 2022

Energy Policy Review

Uzbekistan's broad economic reforms were expanded to cover energy in 2019 when the government launched a multiphase transition from the state-owned and -operated and subsidised energy sector model to competitive gas, oil and electricity markets with significant private-sector participation and cost-covering energy prices.

The reform plans to diversify the country's energy supply, which domestic natural gas continues to dominate in all sectors, including transport. Natural gas exports will be phased out by 2025 and the gas will be used increasingly to expand petrochemicals production, while Uzbekistan's significant but unexploited solar and wind resources will be harnessed to help build a cleaner power sector to 2030. While energy use per capita is low, the country's economy remains one of the most energy-intensive in the world, and massive potential remains to improve energy efficiency through incentives and mandates.

This report is intended to help guide Uzbekistan towards a more secure, sustainable and efficient energy future. It proposes several ways to support the government in its reform efforts. The gradual transition to competitive markets and withdrawal of subsidies should be accompanied by support measures for those most in need. For the reform to succeed, an independent and well-resourced energy regulator is also necessary. Furthermore, the financial imbalances in the state-owned energy companies must be addressed and their re emergence avoided.

For the long term, as Uzbekistan's population, cities and economy are projected to grow strongly, a cross-sectoral approach is required to limit the increase in energy demand and energy-related greenhouse gas emissions.

International Energy Agency

Co-funded by the European Union