Sustainable Pathways to Energy Transition in the CAREC Region: A Governance Perspective

ANNEXURE TO REPORT

January 2022

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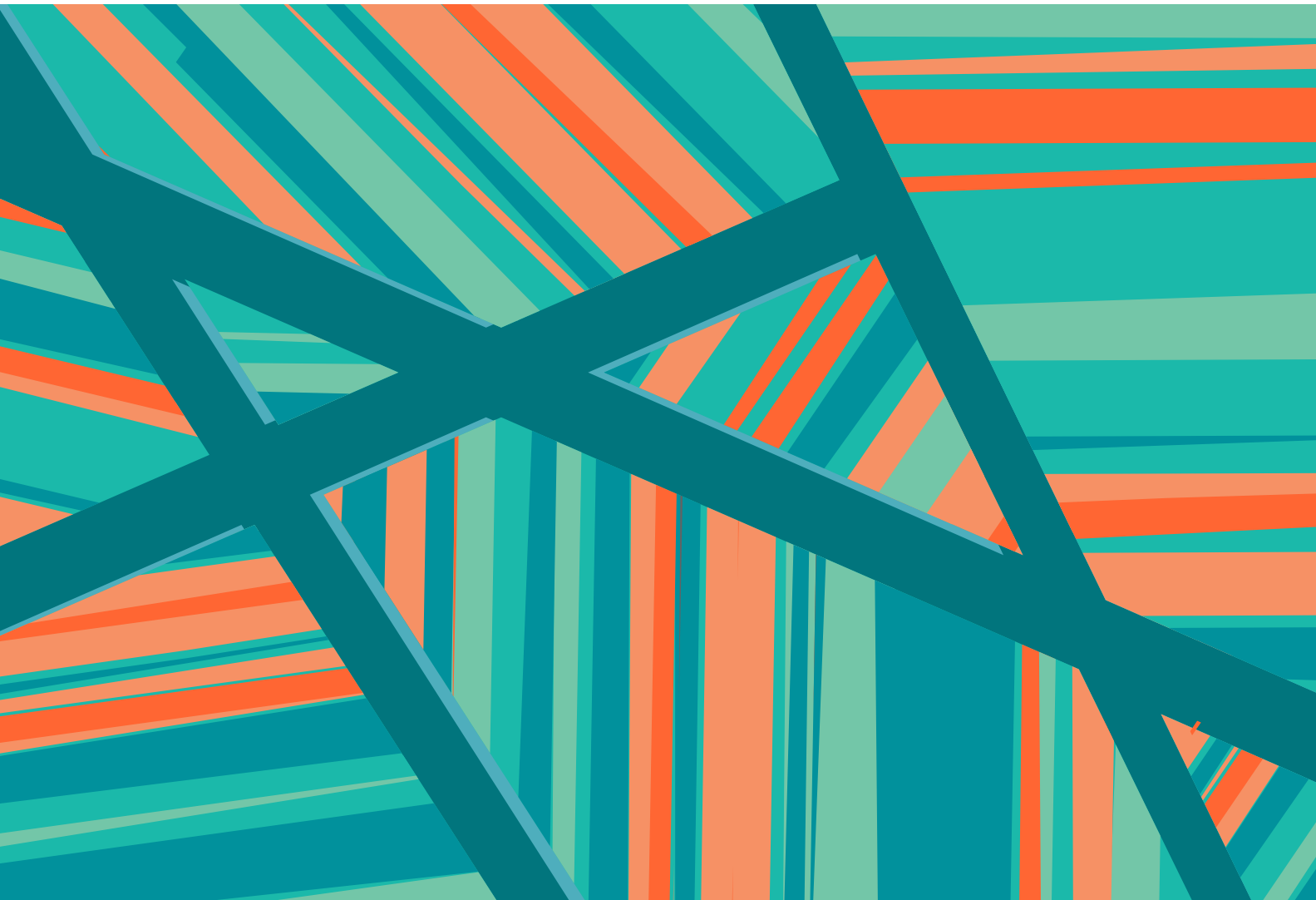

CAREC Institute
Asian Development Bank

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Annexure: Analysis of Governance Structures in Individual CAREC Countries

A. AZERBAIJAN

1. Overview of the power sector

Located between Europe and Asia, Azerbaijan has been a net energy exporter, exporting oil, natural gas, and electricity. The energy sector in Azerbaijan has undergone several phases of restructuring since the country's independence in 1991, with focus on the power sector. Power generation from RE resources, (except for hydropower), was almost non-existent till 2010. Total installed electricity generation capacity in Azerbaijan in 2019 (**Table 2.1**) was 7,700MW. About 83 percent (amounting to 6,400MW) of the electricity generated in the country in 2019 was derived from combusting fossil fuels. Relatively smaller amounts of renewable energy capacities were installed by 2019, with 1,140MW of hydropower plants, 400MW of solar PV, 700MW of wind energy, and close to 500MW of bioenergy and waste-to-energy capacity.

The annual electricity production in Azerbaijan increased from 18,700GWh in 2010 to 26,100GWh in 2019 (as indicated in **Table 2.2**). Azerbaijan has cross border electricity connections with Georgia, Turkey, Russia, and Iran. In 2019, the country exported 1,500GWh of electricity and imported 100GWh. The Azerbaijan–Georgia–Turkey (AGT) *Power Bridge* line set up in 2016 has helped the country increase electricity exports. The country routinely exports electricity mostly to Georgia. **This interconnection could be relevant in the context of the proposed regionwide optimization of supply and demand conditions.** The data presented within **Table 2.2** shows that the country's reserve electricity capacity had been declining since 2010. Increased awareness that the country requires investment into additional capacity to improve its energy security, and to maintain adequate capacity reserves is manifest in recent years.

A major proportion of the power sector infrastructure was built during the Soviet era (pre-1989) and by 2016, nearly 20 percent of the power plant equipment had been operated beyond the projected useful life. The power transmission and distribution facilities in many districts were over 30 years old and had become less reliable, resulting in more frequent outages and increasing losses.[1] In July 2018, the country experienced two major blackouts affecting 39 cities and many districts across the country, leaving some areas without water for a few hours. The Government of Azerbaijan tied up with a German company VPC to restore the power system's generating capacity, to modernize the substations, and to increase the transmission system's load capacity.[2] **However, a regulatory framework for monitoring power quality is yet to be set up in the country to constantly monitor the systems and to implement consistent procurement, project implementation, and service delivery processes.**

Azerbaijan is reported to have achieved 100 percent electrification in both urban and rural areas. The country's high voltage transmission network includes 110kV, 220kV, 330kV, and 500kV and transmission lines, covering a distance of 7,800 km. It is reported that the proportion of transmission losses within total electricity supply fell from 2.1 percent in 2015 to 1.5 percent in 2019, and distribution losses from 9.6 percent in 2015 to 7.5 percent in 2019. The Asian Development Bank (ADB) provided a loan of USD 750 million to fund *Azerishiq's* program to rehabilitate distribution network substations and lines, to replace low quality customer service lines and to install smart meters across the country. As of October 2021, this modernization program was still under implementation and was scheduled for completion[3] by 2022. Metering of energy supplied has helped increase the collection rates from 50 percent in 2007 to 94 percent in 2018 and consequently to improve the financial performance of the electricity sector.[4]

The end user electricity tariff rates in the country are as shown in **Table 2.3.** The 'tariffs for producers' listed are feed-in tariffs (FiT) for small RE producers, while the 'wholesale electricity tariff' listed is the tariff that the DSO *Azerishiq* pays to the TSO *Azerenergy* for electricity. The transit tariff is the tariff *Azerishiq* pays for the transmission of electricity from its three wind power plants. The several energy intensive industries that are supplied directly from the transmission network are also eligible for daytime and night time tariffs. On the retail side, block tariffs ('telescopic tariffs') apply to residential consumers and a flat rate tariff to all other consumers, regardless of category, voltage, or capacity. The tariff system also provides implicit cross subsidies from urban to rural customers: even though retail electricity tariffs—which include compensation for distribution—are the same across the whole country, it costs *Azerishiq* much more to supply rural customers than urban ones. Essentially, demand per customer is lower and capital costs higher in the countryside ('low average revenue per end user'). The tariff system inherently includes cross subsidies among consumer groups and energy carriers as well as direct subsidies from the state budget.

Given the cost structures, according to the International Energy Agency of 2021, the domestic energy sector's financial viability was under threat, and the report observed: '*Investments are needed to modernize and expand electricity, heat, and gas infrastructure, but incentives have been weakened by a lack of competition and low end user tariffs.*'[5] More efficient use of power generating assets as proposed within the present report and improved matching of demand and supply might serve to ameliorate the situation.

2. Principal agencies and institutions

The **Ministry of Energy (MoE)** is the central executive authority for implementing state policy and various regulations, orders, and decrees for the energy sector that are issued by the government. The Cabinet of Ministers, accountable directly to the country's president, approves the appointment of members on to the ministry's board, which has the authority to issue related orders within the domains of the energy sector, except tariff regulation.[6]

The main functions[7] of the ministry include:

- Identifying promising niches to draft state and regional programs and ensuring their implementation
- Forecasting the production of various energy sources
- Participation in international cooperation agreements in the energy sector
- Monitoring energy supply activities for all industrial sectors in accordance with norms and laws

- Creating favorable conditions for external and domestic investment in this sector issuing licenses
- Ensuring sufficient energy in the domestic market
- Research and development in the energy field
- The application of international standards and experiences within the country
- The preparation of measures aimed to reduce potential losses in the process of production, transportation, distribution, and use of energy resources
- Preparation of energy security programs for the Republic of Azerbaijan
- Preparation of energy efficiency programs

The **Tariff Council** determines the retail and wholesale tariffs for electricity including purchase tariffs for renewable electricity. The Tariff Council is headed by the Minister of Economy: other members of the council include the deputy ministers of finance, justice, energy, transport, communication and information technologies, agriculture, health, education, labor, and social defense of the people, the vice chairmen of the Committees of Customs and of State City Building and Architecture and the deputy chairman of the State Tax Service. A new law, *Law on the Regulator*, drafted in 2019, proposes to transfer all functions of the Tariff Council to the Azerbaijan Energy Regulatory Agency (AERA). The AERA was established in 2017 to regulate producers, transmission operators, distributors, suppliers, and consumers in the fields of electricity, district heat and gas supply. AERA also undertakes energy market analysis; proposes restructuring measures; and develops the investment climate.

Azerenerji OJSC is the body that is responsible for generation and transmission of electricity in Azerbaijan. Azerenerji purchases natural gas from the State Oil Company of Republic of Azerbaijan (SOCR) for electricity generation. The utility company introduces new technologies to ensure extension of generation capacity and rehabilitation of high voltage power lines in the country. Azerenerji also conducts energy exchange operations with foreign countries. Azerishiq implements all investments in the distribution network. It is also responsible for carrying out large scale rehabilitation of infrastructure and works on the electrification program for residential communities. Azerishiq operates in the regional networks of Aran, Baku, Canub, Garb, MarkaziAran, Shimal, and Shimal Garb. In the Nakhchivan Autonomous Republic, transmission and distribution systems are directly operated by the Nakhchivan Energy Authority.

In September 2020, the State Agency for Renewable Energy Sources was established, reporting to the MoE. Under the State Agency on Alternative and Renewable Energy Sources, the state owned company *Azalternativenergy* LLC implements RE projects, generates, transmits, and distributes electricity from alternative and renewable energy; and provides construction and engineering services to both the private sector and the government.[8]

Apart from these independent bodies, a few other ministries are **indirectly involved** with the energy sector. The Ministry of Ecology and Natural Resources is responsible for implementing state policy on environmental protection. The Ministry of Emergency Situations oversees emergency response mechanisms in all sectors of the economy. The State Statistical Committee of the Republic of Azerbaijan (SSC) is responsible for official energy statistics and meets regularly with the MoE to discuss data findings and potential additional information needs.[9]

3. Legislative framework

The major laws and by-laws in the country related to the electricity sector are as follows.

Law on the Use of Energy Resources (1996)[10]**—**This law regulates the legal, social, and economic basis for the.country's policy in the field of energy resource utilization and regulates the relations between the state and the legal entities in this field. The law includes provisions for the certification and standardization of energy consuming installations, facilities, and so on.

Law on Electric Power Industry (1998)[11]**—**The electricity policy of Azerbaijan is implemented through the Law on Electric Power Industry of 1998 which provides for generation and distribution of electric and thermal power energy, tariff setting, regulation of power markets, export and import of electricity, safety of power generation, transportation, distribution and consumption, and standards and norms for the operation of electricity and thermal power plants. The policy promotes a balanced integration of economic and environmental dimensions of sustainable development, focuses on the sector specific strategy for the environment. The law appoints and empowers the Ministry of Energy for licensing agencies and regulating generation, transmission, distribution, sale, and import–export of electricity.

Law on Heat and Electric Power Plants (1999)[12]**—**This law is responsible for determining the legal framework for design, construction, and operation of power plants. This includes independent power plants. The law guarantees the purchase of electricity from small power plants without limitations. In Azerbaijan, a small power plant is defined as one with a capacity between 50kW and 10MW (primarily defined from the point of view of hydropower plants) and between 10kW and 100kW for wind energy generation. As per this law, any legal entity has the right to construct, rehabilitate, and operate power plants. However, activities relating to 'industrial power plants'—that is, power plants other than small power plants as defined previously—are licensed by the Ministry of Energy. The law also provides for the process steps and the conditions of negotiated access and connection of such industrial power plants to the grid network.

As of October 2021, Azerbaijan did not have specific laws on RE or EE, but such laws had been drafted and had been submitted to the National Assembly in April 2021 for approval.[13] At the time of development of the present report, there were no specific policies or incentive schemes for promoting energy efficiency. However, the draft Law on the Efficient Use of Energy Resources and Energy Efficiency was to be submitted by the President to the Parliament for a debate. The government was also involved in the development of a national energy efficiency action plan (NEEAP).[14]

The country also had formulated several by-laws aimed at promoting the use of renewable energy through special concessions, including:[15]

- The State Program on the Use of Alternative and Renewable Energy Sources, adopted in 2004
- Decree of the Cabinet of Ministers 'On determination of electricity production and power limits for the commissioning of electrical installations'—no. 482 of 24 November 2016
- March 2014 amendments to the Cabinet of Ministers' decree: 'Rates of custom duties on export–import operations in Azerbaijan Republic' and 'List of goods exempted of VAT imported to Azerbaijan Republic territory.'

A **new Law on Electricity** promoting market liberalization was drafted in early 2021 and as of October 2021, approval for this law was pending in the National Assembly. Agreements for power purchase and sale, investments, transmission network connections, and land leases had also been drafted with the help of international consultants. Business models for cogeneration of heat and power (CHP) and generation of power, heat, and cooling were also being explored under the new law.[16]

4. Private investment and grievance redressal for investors

Azerbaijan attempted to privatize the distribution services in early 2000. However, owing to unsatisfactory performance of the private agencies, the distribution services were transferred back to a government owned agency. Private sector investments in the power generation sector account for a small portion of the total installed capacity and their presence is limited to small hydro based power plants and few RE based projects. The generation by independent power producers (IPPs) was in the region of 2,000GWh in 2014, which was about 8 percent to 9 percent of the total power generated at the time**.**

The **Law on International Arbitration of November (1999)** (the International Arbitration Law) and the Civil Procedure Code of Azerbaijan, effective from September 2000, governed the enforcement of awards issued by an international commercial arbitration tribunal and other related issues.[17] According to the Law on Foreign Investment (1992), foreign investors had the right to international arbitration of investment and other commercial disputes with state authorities or other entities only if the concerned parties had previously agreed to arbitration. As per this law, the foreign states, along with their legal entities and citizens, and international organizations engaging in investment activities in Azerbaijan were treated as foreign investors.

5. RE sector development scenario and observations

The International Energy Agency had observed that the low price of natural gas in Azerbaijan discouraged the use of RE for electricity production. Further, as the price structure favored individual gas boilers for space heating, it inhibited the use of potentially more efficient system solutions such as district heating and cooling, electricity and heat pumps. The subsidies paid out to the electricity sector (presented in **Table 2.4)** have been rising consistently except for 2019 when the quantum of subsidies appears to have declined relative to the previous year.

It was estimated that an investment of approximately USD5,014 million would be required for the power generation and transmission projects between 2017 and 2023. The government planned to spend the money in a phased manner as indicated in **Table 2.5.** The present status of these investments is not immediately apparent. While the proposals to invest into RE and grid network infrastructure might be aligned with the country's development plans, there might be a case to be made to redirect the investments proposed for thermal power plants to lower carbon generation capacity.

The Ministry had identified eight potential areas for the construction of solar and wind power facilities of about 100MW to 200MW each, and had planned to employ auctions to invite and select project participants. The Ministry had also signed memorandums of understanding (MoU) with 11 large companies, including BP, Equinor, Total, Masdar, and ACWA Power to cooperate on RE ventures. In January 2020, an MoU was signed with *ACWA Power* (of Saudi Arabia) to build, own, and operate 240MW of wind capacity and with UAE based *Masdar* for 230MW of solar capacity.

Project agreements, including 20 year PPAs, were signed in December 2020 with ACWA Power and in March 2021 with Masdar.[18]

Azerbaijan possesses adequate RE potential to meet the country's electricity demand, as indicated in **Table 2.6.** Small hydro[19] (plant size less than 10MW in capacity) potential in the country is estimated at 520MW and the target determined for commissioning by 2030 stood at 220MW in small hydro capacity. The country is endowed with wind energy potential of 3,000MW and has targeted 465MW of wind energy generation to be installed by 2030. Likewise, solar energy potential is estimated at 23,040MW while the target determined is just 190MW. Relative to the potential, the installation capacity targets set to be achieved by 2030 appear modest. The scenario for regionwide optimization of generation and consumption discussed in the subsequent chapter **envisages the addition of over 13,000MWp** of solar PV capacity to contribute to displacing fossil fuel generation capacity in the region by 2030.

6. Energy efficiency

With a RISE score of 48, Azerbaijan stood below the regional average (by 18 points) and below the global average (by 13 points) indicating that the country had the lowest EE score among all countries covered by the present study.[20] The global lowest RISE score on energy efficiency stands at 2.

The energy intensity of Azerbaijan's GDP had been declining over the past 15 years and in 2018 was estimated at 500kg of oil equivalent per USD1,000 of GDP. Yet, this estimate was more than thrice the global average of 156kg of oil equivalent per USD1,000. On this measure,[21] Azerbaijan ranked 120th among 180 countries of the world.

On 30 May 1996, the Republic of Azerbaijan adopted a law on the use of energy resources. This law is the key document regulating EE as it defined the legal, economic, and social foundation of state policy and governed relations among the agencies involved. However, not all provisions of the law had been enforced since its adoption. For example, the law stipulated the establishment of an *energy fund* which had never been created. As of October 2021, there was no *National Energy Efficiency Action Plan* (NEEAP) in Azerbaijan. However, once adopted, the new Law on Energy Efficiency (EE) would mandate the development of a five year NEEAP. The Ministry of Energy was also required to coordinate EE related activity with agencies concerned with industry, buildings, and transportation.[22]

7. Review of the framework in Azerbaijan

- Azerbaijan could benefit from the setup of a regulatory framework for monitoring power quality: this framework could also provide guidance to shape the economic aspects of the energy sector.

- Further to the legal framework, Azerbaijan could benefit from the constitution of an independent regulatory body with clear responsibilities and appropriate powers, to determine end user tariffs and to revise such tariffs periodically, to enable third party access to the grid on non-discriminatory terms and to enhance confidence among private sector investors.

- To attract investors into power generation, while also ensuring improved quality of electricity services to all sections of society, the electricity sector needs to be financially viable. This can be achieved by the efficient use of generation side assets, through effective targeting of subsidies, and through improved matching of supply with demand. Telescopic tariff structures (block tariffs) could be implemented based on predetermined thresholds to offer low prices for low end consumption, while charging higher end consumers premium rates. In future, the utility concerned could consider introducing time-of-use tariffs and prepaid meters as well.

- The AERA was set up with the purpose of pursuing energy sector unbundling and preparing tariffs for approval by the Tariff Council. However, when the National Assembly passes the *Law of Regulators*, all the functions of the Tariff Council would have to be passed on to AERA, which in turn, reports to the MoE. It is unclear if the Tariff Council would continue to exist to design tariff structures and to approve tariffs sought by utilities concerned.

- According to the IEA report on Azerbaijan, 'the current network tariffs for electricity are based on a *cost plus* methodology that does not encourage utilities to make their services more cost efficient. Contrarily, this method provides a perverse incentive for utilities to raise their operational costs to justify additional regulated revenue.' The country needs to develop a transparent electricity tariff setting methodology that will incentivize investment in efficient power sector development. The state owned transmission and distribution bodies, *Azerenrji* and *Azerishiq*, also reported to MoE. If the independent *Tariff Council* were to be eliminated and if an agency reporting to the MoE were to decide tariffs to be collected by other entities also reporting to the MoE, this might represent a situation with implicit conflicts of interest.

- The independent regulatory authority might serve to attract investments into RE capacity addition, through executing long term power purchase agreements (PPA), streamlining authorization, and licensing processes as well as through streamlined and consistent project implementation procedures.

- Given the RE potential available in Azerbaijan, auction mechanisms as well as tariff structures could be customized to suit different technologies, and such tariffs could be structured to incentivize power plants to operate and supply during the winter months as well as during the summer months.

Table A1: Installed electricity generating capacity (MW)

Energy source	2005	2010	2019
Renewable energy			
Hydro	970	1,000	1,140
Solar PV	0	0	400
Wind	0	0	700
Combustible fuels			
Oil	0	0	300
Gas	4,290	5,500	6,360
Bioenergy and waste	0	0	500
Total capacity	5,260	6,500	7,700

Source: International Energy Agency (2021) 'Azerbaijan 2021 Energy Policy Review.' page 73. Retrieved on 4 October 2021 from https://iea.blob.core.windows.net/assets/49662c46-575f-4561-a541-5541f5342b07/Azerbaijan2021EnergyPolicyReview.pdf.

Table A2: Azerbaijan Electricity Balance GWh

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Production (P)	18,347	20,300	23,000	23,400	24,700	24,700	25,000	24,300	25,200	26,100
Imports (I)	116	116	141	127	124	108	114	116	116	100
Consumption (C)	12,234	13,267	15,395	15,982	16,907	17,619	17,618	17,096	17,794	22,460
Exports (E)	465	814	680	496	489	265	1096	1279	1396	1500
Excess (P+I-C-E)/reserve	5,764	6,335	7,066	7,049	7,428	6,924	6,400	6,041	6,126	2,240
Reserve as percent of consumption	47.11	47.75	46.00	44.10	43.93	39.20	36.32	35.33	34.43	9.97

Sources: Author calculations based on published reports (CAPE Azerbaijan: Linked Document B, CAREC TA-8727 Country Report Azerbaijan, IEA (Azerbaijan energy profile—Analysis—IEA), IEA Sankey Diagram) Retrieved on 4 October 2021.

Table A3: Azerbaijan electricity tariffs 2020

	Service	Tariff (AZN/kWh, including VAT)	Tariff (US cents/kWh, including VAT)
1.0	Tariff for producers		
1.1	Small hydropower	0.05	2.95
1.2	Wind power	0.055	3.25
1.3	Monthly consumption up to 300kWh	0.057	3.36
2.0	Wholesale tariffs		
2.1	Energy intensive industry (chemicals, aluminium and steel enterprises with monthly consumption of at least 5GWh)		
2.1.1	Daytime (08:00-22:00)	0.058	3.42
2.1.2	Night time (22:00-08:00)	0.028	1.65
*3.0	Transit	0.02	1.18
4.0	Retail tariff		
4.1	Residential		
4.1.1		0.07	4.13
4.1.2	Monthly consumption more than 300kWh	0.11	6.49
4.2	Non residential	0.09	5.31

Note: AZN 1 = USD0.59/USD1 = AZN 1.70

Source: International Energy Agency (2021). Azerbaijan 2021 Energy Policy Review. Page 81, Retrieved on 5 October 2021 from https://iea.blob.core.windows.net/assets/49662c46-575f-4561-a541-5541f5342b07/Azerbaijan2021EnergyPolicyReview.pdf

Table A4: Azerbaijan electricity subsidies (USD million)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Electricity subsidy	264	296	352	427	326	591	699	757	956	483

Source: IEA (2021). Retrieved on 7 October 2021 from https://www.iea.org/topics/energy-subsidies.

Table A5: Electricity sector investments planned 2017-2024 (percent)

	2017	2018	2019	2020	2021	2022	2023	2024
Percent for RE projects	15	25	30	30				
Percent for transmission projects			15	25	30	30		
Percent for thermal power plants	10	20	20	16	14	10	10	
Percent for repair and maintenance of distribution lines	10	15	15	12	12	16	10	10

Source: CAREC (2016) *ibid* Page 24

Table A6: Azerbaijan RE resource potential and targets for 2030

Energy source	Potential (MW)	2030 targets (MW)
Wind	3,000	465
Solar (PV)	23,040	190
Bio/waste	380	50
Small hydro	520	220

Source: IRENA (2019). Renewables Readiness Assessment: Republic of Azerbaijan. Page17. Retrieved on 7 October 2021 from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Dec/IRENA_RRA_Azerbaijan_2019.PDF.

B. CHINA

1. Overview of the power sector

China has experienced rapid economic growth since the 1990s, which led to rapid growth in the demand for electricity. It is estimated that China accounted for 27 percent (7,170TWh) of global electricity generation in 2018. Further, the demand for electricity in China grew at a rate of 7 percent per annum between 2010 and 2018. To meet this rapid growth in demand, China invested in various sources of power generation. **Table 2.7** presents the power generation mix in the country as of 2018: at the time, 66 percent of China's electricity was produced from coal, 17 percent from hydropower, 4 percent from wind, 4 percent from nuclear, 3 percent from natural gas, and 2.5 percent from solar energy. The total estimated electricity generation in China has increased from 5,024TWh in 2012 to 7,140TWh in 2018, as presented within **Table 2.8**. Electricity consumption in the country has also been increasing steadily reaching a total consumption of around 6,222TWh in 2018.

As reported by the IEA, the feed-in tariffs and retail prices vary in different provinces or regions of China. They are regulated by the government and are updated and approved by the NDRC periodically. Provincial governments determine the 'benchmark' feed-in tariffs, and report such benchmark figures to the central government for approval. Feed-in tariffs are offered for each type of resource and are based on the economic development of the province concerned. For instance, in 2018, the feed-in tariff for coal power in the less developed, coal rich province of Gansu was benchmarked at CNY 297.8/MWh, equivalent to USD47.1/MWh. At the same time, the feed-in tariff in the more developed but coal poor province of Guangdong was benchmarked at CNY 450.5/MWh, equivalent to USD71.25/MWh. It is also observed that hydropower plants usually have the lowest price, followed by coal, nuclear, gas, wind, and solar power plants, in ascending order.[23]

The benchmarked retail price takes into account the on-grid purchase cost, transmission and distribution loss, transmission and distribution price, and government charges. The retail price has four pricing categories depending on the type of end users: (i) large scale industrial, (ii) commercial and industrial, (iii) agricultural, (iv) residential. Retail prices varied within each pricing category depending on voltage level and the time of use. Prices owing to different times of use were typically divided into 'peak,' 'normal,' and 'valley' prices. Some provinces had implemented a demand based pricing mechanism for the retail price of large industrial consumers and commercial consumers with high voltage consumption. Other areas had implemented a differentiated residential price (referred to as the 'ladder residential price') to encourage household energy saving.[24]

China's provincial agencies played important roles in China's highly fragmented policy development process.[25] Decentralization in policy making was a major factor that enabled market reform and transformation in China's electric power sector. A consensus had to be reached among government departments and diverse interest groups involved in negotiating processes, before a policy decision concerning market reform could be made.

Several cross border transmission projects connect China to the Russian Federation, Kazakhstan, Pakistan, and Mongolia. The construction of cross border transmission projects was subject to approval by the NDRC. However, for approval, such projects must be filed with the *State Council* if the voltage:

- Of a direct current (DC) cross border transmission project is more than 800 peak kVp (kVp)
- Of an alternating current (AC) cross border transmission project is greater than 1,000kVp
- Tariff rates for the transmission services are subject to the approval of the NDRC

In 2019, the total import of electricity into China was 5,258.612 million kWh, which was equivalent to 0.07 percent of the total electricity consumption and amounted to USD186.1 million in value. The total export of electricity in 2019 was 21,654.82 million kWh, which was equivalent to 0.29 percent of the total electricity generation and amounted to USD1.587 billion in value.[26]

2. Principal agencies and institutions

Multiple institutions are involved in supervising and overseeing the functioning of the electricity sector in the country. The **National Development and Reform Commission (NDRC)** and the **National Energy Administration (NEA)** are responsible for issuing and implementing industrial plans, policies, pricing, and energy sector regulation. There are a total of eight departments under the NDRC and NEA involved in regulating various aspects of electricity services in the country.

Under the NDRC:

- The Department of Economic System Reform leads the power sector *reform* in China.
- The Department of Pricing is in charge of the *regulation of power prices*, including determining benchmark prices of coal based power, feed-in tariffs for renewable energy projects, and interregional and interprovincial transmission and distribution tariffs.
- The Department of Economic System Adjustment is in charge of demand side management (DSM) and of reform related to administrative generation planning.
- The Department of Basic Industry is in charge of integrating the power industry plans within the country's macroeconomic development plan, ensuring that the targets of power sector reform do not conflict with the broader national economic targets.

Under the NEA:

- The Electricity Department focuses on fossil fuel power generation planning and grid planning, electric vehicle charging facilities, and incremental distribution grid reform.
- The Renewable Energy Department is in charge of renewable energy development and integration.
- The Energy System Reform Department is in charge of institutional aspects of the reform.
- The Market Regulation Department is responsible for regulation of the power sector.

Apart from the government departments listed above, a number of state owned agencies and private participants are involved in the generation, transmission, and distribution of power in the country. The grid companies which are involved in transmission and distribution also operate as retailers connecting to the end consumers. The **State Grid Corporation of China (SGCC), the China Power Southern Grid (CPSG) company and the Inner Mongolia Electric Power Company** are the main grid companies in the country.

China has also established several electricity trading centers including a regional trading centre in Beijing to cover interprovincial transactions in the *State Grid Corporation of China* (SGCC), and a regional trading centre in Guangzhou to cover interprovincial transactions in the *China Power Southern Grid* (CPSG). On these platforms, electricity generators, distribution companies, and large electricity users can directly sell and purchase electricity and help discover prices. For distribution

system projects where the project owner was not determined through a public bidding, the price authority determined the charges for the distribution of electricity through one or more of the following three pricing methods while ensuring consistency across projects of the same type[27]:

- **Permitted income method:** In this method, the price authority calculates and determines the annual permitted income of the project company. It takes into account the permitted cost, profits, and taxes, and calculates the charges for electricity distribution by dividing the annual permitted income by the estimated quantity of electricity distribution.
- **Maximum price limit method:** This method determines the maximum price limit based on the permitted income method. However, it also considers the electricity distribution charges charged by other comparable distribution network projects in the province. Other performance factors, such as service quality and power supply reliability, are also taken into account.
- **Scale competition method:** This method considers only the weighted average of the charges calculated as per the permitted income method, and the charges of other comparable distribution network projects in the province.

3. Legislative framework

The main laws and the attendant regulations relating to the electricity sector under the Constitution are as follows:

- The **Electric Power Law of 1995** (amended in 2018)
- The **Renewable Energy Law of 2005** (amended in 2009)

The regulations enacted by the State Council, the highest administrative authority in China, include the following:

- Regulations on the Protection of Power Facilities (1987), amended in 2011
- Regulations on Supply and Use of Electric Power (1996), amended in 2019
- Regulations on the Administration of Power Grid Dispatching (1993), amended in 2011
- Regulations on Electric Power Supervision (2005)
- Regulations on the Emergency Response to and Investigation and Handling of Electric Power Safety Accidents (2011)
- Power Sector Reform Scheme, also referred to as 'Document No. 5': The purpose of this reform was to eliminate the monopoly of the *State Power Corporation* (SPC), and to introduce competition. The reform therefore disaggregated the SPC generation assets and grid assets into five generation companies, two grid companies, and four power service companies.
- Opinions on Further Deepening the Reform of Power System, also referred to as 'Document No. 9': The objectives of this document were to create market based prices for the wholesale and retail sides, to develop market mechanisms to establish a separate, transparent transmission and distribution tariff to expand interprovincial and interregional transmission to enhance government regulation and to improve power planning.

Several ministries have issued decrees with respect to the electricity industry, and over 1,000 decrees are believed to be currently in force. The principal decrees covering the subject include the **Provisions on the Administration of Electric Power Business Licences** and **the Power Business Rules**

issued by the State Electricity Regulatory Commission. The Commission itself was subsumed into the National Energy Administration (NEA) in 2013.

In addition, a range of local laws and government decrees relating to the electricity industry are said to be in force in China. Most of the interpretations of these laws and decrees are based on the judgments of the Supreme People's Court reached in response to specific issues within the lower courts' cases regarding the application of laws and regulations.

4. Private investment and grievance redressal for investors

The power generation in China is dominated by state owned agencies, although private players are permitted for some technologies. *China Energy Investment Corporation*, Huaneng, Huadian, Datang, and State Power Investment Corporation were among the top electricity generation companies in China. As of 2017more than 7,000 power retailers operated within the country.[28] For electricity distribution system projects for which the project owner was determined through a public bidding, the tariff for the distribution of electricity was determined by the bidding process ('reverse auction').

The Chinese Government is required to have a controlling stake in the building or operation of nuclear power plants according to the *Special Administrative Measures (Negative List) for the Access of Foreign Investment (2020)* jointly issued by NDRC and the Ministry of Commerce, while the minority stake could be held by expatriate entities. Other than this very specific stipulation, no restrictions concerning the foreign ownership of electricity companies or assets are imposed under Chinese law. However, owing to the (natural) monopoly of grid companies in the electricity sector, in practice it is difficult for foreign companies to own transmission and distribution assets. China, however, is looking at revising the rules relating to foreign ownership: investment restrictions might be lifted on foreign investments into coal, oil, gas, power generation, and new energy businesses[29]—except nuclear energy—during the 14th five year plan period between 2021 and 2025.

5. RE sector development scenario and observations

The estimated RE potential in China is as presented in **Table 2.9.** China has a technical potential of 400GW to700GW of hydropower, 1,300GW to 2,600GW of onshore wind, 200GW of offshore wind, 2,200GW of solar PV (utility scale), and 500GW of solar PV (rooftop). Apart from solar and wind, the country is also evaluating 'green hydrogen' as an energy source. The China Hydrogen Alliance has projected that 20 percent of the country's energy in 2060 could be derived from green hydrogen.[30]

China targets increasing the total share of solar and wind energy in the country's energy mix to nearly 30 percent by 2030. Since determining such targets, China has been implementing necessary steps to achieve this ambitious goal. Owing to such policy measures, and given the market opportunity, China was ranked 2nd on the 57th edition of the Renewable Energy Country Attractiveness Index ('RECAI'; rank 1 being the most attractive RE market) published by Ernst & Young (EY) in 2021. China and Kazakhstan (rank 36) were the two CAREC region countries to have made the list of the top 40 countries in this index.[31]

Power demand in the country has been rising mainly owing to adverse weather conditions. Heat waves in China in 2021 resulted in new peak consumption with such peaks nearly 10 percent higher than the peaks witnessed in previous years. Winter consumption at the beginning of 2021 was also reported to be 4.7 percent higher than normal.[32] In a bid to retain the country's image as a reliable

manufacturing base, the government ordered coal mines to reopen in October 2021. The European Union Chamber of Commerce had projected that China's energy shortages might[33] last until March 2022 and the operations of coal fired power plants might leave an adverse impact on the global climate.

6. Energy efficiency

The Chinese economy is very energy intensive. In 2018 for instance, China is estimated to have used 15 percent more energy in generating one unit of GDP compared to the USA, 59 percent more when compared to India, 66 percent more relative to Japan and 82 percent more relative to similar estimates for Germany.[34] The energy intensity of China's economy is often attributed to the high share of heavy manufacturing in China's economy and the lack of market signals to motivate energy efficiency in some sectors.

China has formulated a large number of regulations in the area of energy efficiency and energy conservation. The principal statutes include:

- Energy Conservation and Emission Reduction 12th Five Year Plan
- Thousand Companies Energy Conservation Action Plan
- VAT Policy for Resource Comprehensive Use
- Energy Conservation Project
- High Efficient Industrial Electric Motor Promotion Catalog
- EE and New Energy Vehicle Demonstration and Promotion Project
- Design Standard for Energy Efficiency of Residential Buildings
- Shanghai Building Energy Conservation Standard

The 13th Five Year Plan (for 2016 to 2020) contained a mandatory national target to reduce energy intensity to 15 percent below 2015 levels by 2020.[35] The 14th Five Year Plan set an 18 percent reduction target for CO_2 intensity and a 13.5 percent reduction target for energy intensity from 2021 to 2025. In 2017, more than 60 percent of China's energy use was mandated by energy efficiency policies. This is more than any other nation in the world.

7. Review of the framework in China

- Despite the massive buildup of hydropower, solar PV, and wind energy capacity, the energy system in China is dominated by fossil fuels. Coal has been the dominant fuel in the end use sectors as well. In recent times, about 40 percent of the final energy consumption was supplied by coal and 27 percent by oil. This leaves significant scope for improvement in environmental credentials and for enhancing the efficiency and sustainability of the energy sector.

- For CO_2 emissions to peak low and to peak early, the country would need to enhance the efficiency of RE asset use while also focusing on improving the balance between peak generation and peak demand. Agencies concerned could explore the possibility of achieving such optimization through building adequate grid network capacities, appropriate pricing mechanisms, and through increased interprovincial transfer of surpluses.

Table A7: China's power generation mix in 2018

Source	Electricity generated (TWh)	Proportion (percent of total)
Coal	4,732	66
Hydropower	1,219	17
Wind	287	4
Natural gas	215	3
Solar	179	2.5
Nuclear	287	4

Source: (IEA, 2021, July). Retrieved on 19 October 2021 from https://www.iea.org/data-and-statistics/data-product/world-energy-statistics-and-balances#world-energy-balances.

Table A8: Electricity generation and consumption in China (TWh)

	2012	2013	2014	2015	2016	2017	2018
Total generation (G)	5024.13	5477.70	5838.23	5873.12	6210.39	6722.10	7140.78
Total consumption (C)	4175.15	4547.30	4884.57	4919.46	5198.58	5675.41	6222.02
Import (I)	23.26	23.26	11.63	23.26	23.26	23.26	23.26
Export (E)	23.26	23.26	23.26	23.26	23.26	23.26	23.26
Balance/Reserve (G+I-C-E)	848.99	930.39	942.02	953.65	1011.80	1046.69	918.76

Source: Author computations based on raw data provided by the IEA at https://www.iea.org/sankey/#?c=China%20(P.R.%20of%20China%20and%20Hong%20Kong,%20China)&s=Final%20consumption. Retrieved on 21 October 2021.

Table A9: Renewable energy potential in China

Energy source	Potential (GW)
Hydro	250
Onshore wind (>50m)	1,300-2,600
Offshore wind (at depth 5-25m)	200
Solar PV (utility)	2,200
Solar PV (rooftop)	500

Source: IRENA (2014). Remap 2030: Renewable Energy prospects in China. page 47. Retrieved on 21 October 2021 from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_REmap_China_report_2014.pdf.

C. GEORGIA

1. Overview of the power sector

The Georgian economy has been developing at a steady growth rate—although this has been weakened by the global economic crisis and the conflict with Russia. Georgia is classified as a 'middle income country' with an estimated GDP per capita of USD4,046.8. The Georgian power system is characterized by asymmetric generation/consumption pattern owing to low demand and high generation in summer and high demand and low generation in winter, allowing Georgia to export power during the summer period. During winter, owing to the low availability of water for hydropower plants, the share of thermal power in total generation increases to 28 percent from the less than 1 percent in the summer. As of 2018, total installed generation capacity in the country was reported at 4,215MW. About one third of the total electricity produced in the country came from the largest *Enguri* HPP having installed and operating capacities of 1,300MW and 1,200MW respectively. In addition to the *Vardnili Cascade* HPPs (second largest hydropower facility in Georgia) the *Enguri* HPP and other relatively smaller HPPs aggregated about 2,000MW and constituted the pool of regulated hydropower plants. By the end of 2019, the total installed generation capacity in the country stood at 4,247MW, comprising 3,300MW in installed capacity of HPPs and about 925MW in installed capacity of thermal power plants.

The Georgian transmission network is predominantly oriented east–west. A large proportion of the country's energy was generated in the western part of the country (the total installed capacity of the HPPs located at the west amounts to 2,510MW), while the consumption centers were located in the eastern part (Tbilisi–Rustavi node). Such divergence is accentuated during spring and summer, when the higher water flows available in Georgian rivers drive higher output at the HPPs, while the thermal power units located at the east (near Gardabani) are not operated: during these seasons, power flows from west to east.

The government of Georgia has recognized for a few years now, that climate change severely threatens the country's sustainable development, and that climate change is likely to adversely affect various sectors of the economy, including the energy sector. The energy sector in turn is projected to leave its footprint on the natural environment. Given that climate change is modifying the hydrology of Georgian rivers and altering water availability for hydropower generation, the Georgian energy strategy targeted diversification of sources for electricity generation by developing other RE sources such as wind and solar PV projects, as well as by increasing trade with neighboring countries. Georgia hopes to optimize the region's use of available natural resources.

The Georgian transmission network was designed for parallel operation with the North Caucasus and Armenia/Azerbaijan power systems. Specifically, energy generated by the HPPs located in the west of Georgia was transmitted to Russia, while the power plants located in the east of Georgia were supplied with fuel from Azerbaijan. After Georgia gained independence, prices for fuel supply for thermal units of Georgia grew significantly, and the eastern part of Georgia is more frequently supplied with power from the HPPs located on the west. Given the domestic demand as well as the export potential, the Georgian power system endures acute shortage of operating reserves resulting in low power quality in isolated regimes. In addition, when one or more of the larger power units fail, the emergency control system initiates load shedding in the country.

Simultaneously, the construction of the HVDC 'back to back' station in Akhaltsikhe, brought the Turkish energy markets closer for Georgian producers to supply. In addition, this led to the construction of green field power generation projects in Georgia. Further, owing to its geographic location, the Georgian transmission network could potentially be used for energy transit between 1) Russia and Armenia/Iran, 2) Azerbaijan and Turkey, 3) Russia and Turkey, and 4) Armenia/Iran and Turkey.

For the household consumption segment, GNERC notified end use tariffs were of the order of 17 Tetri/kWh (up to 101kWh) including VAT, approximately 22 Tetri/kWh including VAT (101kWh to 301kWh) and of the order of 27 Tetri/kWh including VAT for consumption of over 301kWh. For non-household consumption, the unit rates were determined by the voltage and the rates ranged between 27Tetri/kWh and 33 Tetri/kWh. Several distribution companies offered energy services in the country, and the end use prices offered varied by small margins.[36]

2. Principal agencies and institutions

Georgia had an independent Ministry of Energy, but it was amalgamated with the **Ministry of Economy and Sustainable Development (MoESD)** in November 2017. This merged Ministry with its wider scope was presumed to be better positioned to coordinate energy, and environmental and climate change related policy, simultaneously paying more attention to demand side management.[37]

Since 2017, the Ministry of Economy and Sustainable Development (MoESD) is responsible for state policy in the energy sector as well as policies relating to sustainable development of the country's economy. The Ministry could choose to adopt secondary legislation related to the energy sector through ministerial orders.

The **Ministry of Environmental Protection and Agriculture** develops and implements state policy pertaining to climate change, the environment, and agriculture. It is responsible for environmental impact assessments—including for energy sector projects—as well as for state governance and control over the use of natural resources (except for minerals, oil, and gas).[38]

The **Ministry of Finance (MoF)** sets fiscal policy and oversees government spending. For example, the MoF raised concerns about the possible financial implications of memorandums of understanding (MoUs) and power purchase agreements (PPAs) signed with hydropower project developers.

The **Ministry of Infrastructure and Regional Development** overseas several building renovation projects that have an energy efficiency component and projects that are funded by different donors through the Municipal Development Fund.

The **Georgian Energy Development Fund** is a state owned joint stock company created in 2010 and reporting to the MoESD. The fund's mission is to develop Georgia's RE potential by identifying promising renewable energy projects and supporting their development through prefeasibility studies and preliminary environmental impact assessments, and by identifying investors. The National Forestry Agency, reporting to the Ministry of Environmental Protection and Agriculture, is responsible for sustainably managing the *Georgian Forest Fund*, which involves, among other activities, overseeing multipurpose forest management planning, forest maintenance, restoration and reforestation, and maintaining forest inventories.

The **Georgian National Energy and Water Supply Regulatory Commission (GNEWRC)** established in 1997 was charged with the responsibility of maintaining a balance in the energy and water supply sectors and to secure the interests of both the customers as well as the regulated companies. The commission was required to develop the regulatory framework and to promote a competitive environment while ensuring transparency, fairness, and impartiality.

The responsibilities of the GNERC primarily relate to liberalizing the markets and include:

- Developing and/or approving key electricity and natural gas sector regulations such as the rules of energy supply and consumption, the grid code, the standard conditions presented by the market operator and dispatch and transmission licensees, tariff methodologies, and licensing rules and conditions.
- Issuing licences and regulating the activities of the electricity and natural gas sector licensees; monitoring the energy markets.
- Setting and regulating tariffs for electricity transmission, dispatch, distribution, transit, import and export, and market operator services, as well as for natural gas transportation, distribution, transit, supply, and consumption. Commission also sets caps on wholesale prices for existing plants based on their costs, except for deregulated plants with a capacity below 40MW.
- Resolving disputes among regulated market participants or between consumers and service providers.
- Organising and coordinating energy sector certification processes.
- Ensuring a legal basis for stable supplies of electricity, natural gas, water, and so on.[39]

The market participants include producers (primarily hydropower and thermal power plants), the distribution companies, the Electric System Commerce Operator (ESCO), two high voltage transmission companies—GSE (Georgian State Electrosystem) and JSC Sakrusenergo, and the dispatch licensee. The traditional TSO functions are split between the ESCO and the dispatch center instead of a separate transmission system operator (TSO) or distribution system operator. The ESCO, is a state owned enterprise, and is responsible for balancing surplus and deficit, including emergency export/import and exports of surplus power not sold through bilateral contracts.[40]

3. Legislative framework

The Ministry (MoESD) is entrusted with the responsibility of developing and implementing, in cooperation with the other arms of the Government, the Water Regulatory Commission and other relevant parties, the **State Energy Policy** for a period of at least ten (10) years. The draft of the energy policy was to be debated and adopted by the Parliament.

As additional data on climate change progressively becomes available, the country continues to assess possible impacts of climate change—rising sea levels, weather extremes, changing hydrology, and so on—on the country's energy infrastructure, including hydropower plants and electricity and gas transmission and distribution systems. The country has started paying attention to developing adaptation strategies to minimize the possible negative effects from climate change suffered by the country's energy infrastructure. The key climate change mitigation measures the government envisages are enhancing energy efficiency, deploying renewable energy, and managing the country's forest cover more sustainably. The country has been working on establishing a legal and regulatory framework to transpose the existing *EU acquis* (*acquis communautaire*: the accumulated legislation,

legal acts, and court decisions that constitute the body of European Union law) on EE, RE, and forest management reform.

The state energy policy encompasses the integrated national energy and climate plan of Georgia addressing the dimensions of energy security, energy markets, decarburization, innovation and competitiveness in the energy sector, and the moderation of energy demand. These dimensions are addressed in an integrated way, which recognizes the interactions among the various dimensions. The national plan defines objectives for each dimension and provides a description of the policies and measures planned for meeting each objective. The national plan was to be adopted as an integral part of the state energy policy or as an annex thereto. The national plan was to be prepared and submitted to the Energy Community Secretariat pursuant to the recommendation of the Ministerial Council of the Energy Community.

The Ten Year Network Development Plan of Georgia is developed pursuant to **the Law of Georgia On Electricity And Water Supply** and is developed by the TSO of Georgia JSC the Georgian State Electrosystem (GSE) in keeping with an agreement of transmission licensees *Energotrans Ltd* and *JSC Sakrusenergo.* The latest plan was approved by the Minister of Economy and Sustainable Development of Georgia on 20 March 2020. The ten year plan seeks to reduce uncertainties through structured transmission grid development while also preparing to meet domestic and export demand through a more efficient grid network.

4. Private investment and grievance redressal for investors

In the electricity market, licences are mandatory for the generation, (with the exception of hydropower plants with less than 13.0MW capacity), transmission, dispatch, and distribution activities. Electricity import and export activities are deregulated, and do not require licensing. The GNEWRC is responsible for granting licences for major activities in the power sector (such as, hydropower plants of higher than 13.0MW capacity). The commission establishes licensing terms and rules, and grants, modifies, and revokes licences in compliance with the Law on Licences and Permits. It also establishes tariffs for generation (excluding new power plants in operation since 2008 and existing hydropower plants under 13MW), transmission, dispatch, distribution and retail tariffs, controls observance of licence terms, and issues certificates in the energy sector.

The GNEWRC is also responsible for dispute resolution; such disputes are resolved in open hearings. However, if one or both parties were to disagree with the decision of the GNEWRC, the parties have the option to approach the courts for further resolution of the grievance. Any decision of the GNEWRC can be appealed, and appeals are made to the Constitutional or Supreme Court of Georgia. The decisions relating to tariffs or licence withdrawals that affect the public are appealed to the Constitutional Court. It can also be appealed to the Common Court (in the City Court of Kutaisi).[41]

5. RE sector development scenario and observations

Hydropower offers the greatest potential for a present and future renewable energy source for the country even though Georgia does have wind and solar potential. Georgia's RE potential and ability to exploit this potential via the transmission lines to Turkey and current advanced stages of planning for new hydropower projects, such as the Oni, Mktvari, and Namakhvani hydropower plants (HPPs), make Georgia well placed to benefit from the new aggressive renewable energy initiatives of the EU.

Georgia has no primary legislation dedicated to RE, although aspects relevant to RE exist embedded within the energy legislation, as hydropower has long been the most important electricity source in

the country. In fact, Georgia has one of the largest developed hydropower potentials in the world at about 32TWh per year. Georgia's potential hydropower production is roughly 7.27MWh per capita, which is considerably higher than that of the world's biggest hydropower producers, Norway and Canada.

An amendment to the Law of Georgia on Electricity and Natural Gas creates a possibility for the Electricity System Commercial Operator to buy hydropower produced by new HPPs at the long term fixed tariff during the three winter months. The activities of all newly constructed HPPs have been deregulated, such that they fall outside GNERWC's regulation on prices and licensing.[42]

A National Renewable Energy Action Plan (NREAP) (approved in 2019) was developed in compliance with Renewable Energy Directive No. 2009/29/EC to define renewable energy targets and government actions for achieving them. The government aims to set the 2030 targets in the new NECP, which is currently being developed for 2021 to 2030. The Law of Georgia on Promoting the Production and Use of Energy from Renewable Sources was also developed, submitted to Parliament and approved in three hearings by December 2019. It is a framework law focusing mainly on Georgia's compliance with meeting the Energy Community Treaty requirements, reporting to the Energy Community Secretariat (ECS) and coordinating support policies (for statistical transfer, certificates of origin, and so on) with other Energy Community members. The law and its annexes also contain detailed provisions on setting renewable energy targets, developing the Ten Year Renewable Energy Action Plans and monitoring progress on attaining targets.[43]

6. Energy efficiency

In 2018, Georgia's energy intensity per unit of GDP (PPP adjusted) was estimated at 109 tonnes of oil equivalent (toe)—30 percent above the world average—while its per capita total final consumption (TFC) of electricity was 1.2 toe, which is slightly below the 2017 world average of 1.3 toe.[44] Since Georgia's accession to the Energy Community Treaty, the country has begun to actively create a legal and regulatory framework on EE to comply with the *EU acquis*.

The Ministry of Economy and Sustainable Development (MoESD) is responsible for EE policy development, and three draft laws and several secondary legal acts have been developed with the technical assistance of various international organizations:

1. The draft Law on EE, prepared according to EU EE Directive No. 2012/27/EU, which aims to:
   - Establish a common framework to promote and implement EE within the country.
   - Improve energy savings, increase energy supply security, enhance energy independence, and remove barriers to EE development.
   - Establish a process to develop a national EE target through an energy efficiency action plan, which would also outline measures to meet the target.
   - Provide a procedure to adopt the EE action plan.
   - Institute an energy efficiency obligation scheme and/or alternative policy measures to achieve energy savings.
   - Ensure coordination among parties to control, monitor, and supervise implementation of the country's EE policy.

2. The draft Law on EE of Buildings, prepared according to EU Energy Performance of Buildings Directive No. 2010/31/EU. Several secondary Acts have already been drafted but not finalised to implement this law, which will:
   - Set buildings sector regulations to ensure the improved EE of existing and new buildings.

- Introduce minimum energy performance standards (MEPS) and the obligation to adopt a methodology for calculating the energy performance of buildings.
- Include provisions to establish energy performance certification and the inspection of heating and cooling equipment.
- Introduce sanctions for breaching the provisions of this law.

3. The Law on Energy Labeling, prepared according to EU Energy Labeling Directive No. 2010/30/EU, will regulate the energy labeling of various household appliances. This law was enacted on 26 December 2020. At the end of 2019, the draft law on EE was submitted to Parliament, where a relevant committee was meant to discuss it together with the draft law on EE in Buildings submitted to Parliament back in 2018.

A National EE Action Plan (NEEAP) had been developed in compliance with the EU EE Directive: initiated in 2015 and based on 2014 data, the NEEAP was passed in 2019 after intensive discussions and numerous amendments. The NEEAP targets a 13 percent reduction in total primary energy supply (TPES) and a 9 percent reduction in TFC by 2025, a 14 percent reduction in TPES and a 14 percent reduction in TFC by 2030 compared with the BAU level. However, these targets were determined using model assumptions based on 2014 data and are to be updated. More recently, the government proposed to focus on developing a new action plan with targets until 2030.[45] To effectively implement and enforce the country's EE policy, the MoESD had been considering establishing a special department responsible for implementing the legal framework in collaboration with other entities concerned.

7. Review of the framework in Georgia

- For dealing with load shedding situations, sufficient operating reserves need to be provided through construction of regulated hydropower plants (with adequate water storage) as well as rehabilitation of the existing power plants to enhance the efficiency of generation.

- As discussed within the text above and as observed in the *Qartli* wind farm case following this country profile, the regulatory mechanisms in Georgia might be modified to offer appropriate price and non-price incentives to augment supplies within Georgia during the winter months, while simultaneously contributing to balancing annual demand and supply within the CAREC region.

- To contribute to the replacement of fossil fuel based generation capacity in the region, the present study proposes the addition of 2,272MW of wind energy capacity in Georgia by 2030, in addition to the BAU growth in capacity of hydropower, solar PV, and other low carbon technology options.

D. KAZAKHSTAN

1. Overview of the power sector

The Kazakhstan economy is dominated by the hydrocarbon industry although the government has developed plans to encourage industry to produce high value added goods. It is situated in the center of Eurasia, bordering Russia, China, Kyrgyzstan, Uzbekistan, and Turkmenistan. The electricity in Kazakhstan is generated by a fleet of 158 power plants of various sizes and ownership structures. As of 1 January 2020 the total installed power plant capacity[46] in Kazakhstan was 22,936.6MW and the available capacity was 19,329.7MW. The majority of Kazakhstan's power plants are located in the northeast of the country while the load centers are located towards the southeast. Northern regions in the country meet their own power requirements and transfer the surplus electricity to the western and southern regions.[47] While north–south connections for power transmission exist, the available transmission capacity might be insufficient to meet total demand in the southern part of the country.

The unified power system (UPS) of the Republic of Kazakhstan represents a network of power plants and grids unified by a common operation mode, single centralized operations and dispatch management and emergency control, thereby ensuring reliable and high quality electric power to consumers. The UPS of Kazakhstan operates alongside the UPS of Russia and the interconnected power system of Central Asia (to Kyrgyzstan and the Republic of Uzbekistan). The backbone grid in Kazakhstan for the UPS is the National Power Grid (NPG), which provides electric connections between the regions (north, south, and west energy zones) of the country and power systems of the neighboring countries (the Russian Federation, Kyrgyzstan, and Uzbekistan) and enables power plants to supply electricity.[48] The north and south energy zones are connected by two north–south transmission lines and a third north–east–south 500kV line with a total carrying capacity of 2GW. They are often considered together and collectively referred to as the north–south energy zone. The west energy zone is not connected with the north–south and is balanced by the Urals Integrated Energy System (IES) of Russia's UES. The current structure of electricity production is dominated by coal fired generation (70.4 percent), followed by gas fired plants (19.4 percent), hydropower plants (9.7 percent), and wind and solar plants (0.4 percent and 0.1 percent, respectively). Despite their small share in electricity production, installed capacity of renewable energy options has significantly increased over the recent years owing to active legislative support for this segment.

The unified power system of Kazakhstan operates in parallel with the unified power system of Russia and the unified power system of Central Asia. The power plants are grouped into power plants of 'national importance' (large thermal power plants), power plants of 'industrial importance' (large hydropower plants), and those of 'regional importance' (combined heat and power plants: 'CHP'). Growing demand for electricity and decommissioning of the depreciated equipment at large power plants in Kazakhstan would require significant capacity addition by 2030 (estimated at 10,000MW to 15,000MW), including installed capacity of RE projects.[49]

2. Principal agencies and institutions

With an aim to reorient its policy development structure, significant changes in the Kazakhstan governance structure were adopted in 2014. This helped to facilitate efficiency and reduce the number of ministries from 17 to 12. The change led to the formation of the Ministry of Energy,

which took over the functions of the former Ministry of Oil and Gas, Ministry for Environment and Water Resources, and some of the functions of Ministry for Industry and New Technologies.

The Institutional Structure of Kazakhstan is such that three ministries—**Ministry of National Economy, Ministry of Energy** and **Ministry of Investment and Development**—serve as the regulatory authorities of the power sector. The **Committee for the Regulation of Natural Monopolies** under the Ministry of National Economy is responsible for electricity tariff determination. The Ministry of Energy is responsible for development of the power sector, RE, emission trading, and control over state policy for the development of the green economy. The Ministry of Investments and Development is responsible for the energy efficiency policy, assigned to the *Committee for Industrial Development and Industrial Safety*.[50]

State ownership in the sector is exercised by equity investments of the government via **Samruk-Kazya Joint Stock Company** (JSC). Currently, Samruk-Kazya is the sole shareholder of Samruk-Energy JSC involved in the generation sector. Samruk Energy produces about 38 percent to 40 percent of the power generated in Kazakhstan; ERG (Eurasian Resources Group) produces about 16 percent; AES and MAEK Kazatomprom each produce about 7 percent, and the other companies produce approximately 30 percent of the total power generated.[51]

As a result of the reforms carried out, the National Electric Grid and an open competitive electricity market were established, while high voltage transmission was managed by state owned electricity companies.[52] Further, the state owned electricity companies continued to serve as system operators including:

- **Kazakhstan Electricity Grid Operating Company (KEGOC)**, a 100 percent state owned transmission and dispatch company assigned exclusive rights to serve as the counterparty to RE power purchase agreements
- Electric power and electric capacity market operator **JSC Kazakhstan Wholesale Electric Power Market (KOREM)**
- **Samruk-Energo**, managed by the National (Sovereign) Wealth Fund *Samruk-Kazyna*, alongside KOREM

The Kazakhstan market is served by 20 regional distributing companies, more than 100 transmission companies, and 160 retail supply companies (private as well as publicly owned and managed) who serve as distribution franchisees procuring electricity from generating companies or at auctions to sell to retailers and end use consumers. The electricity prices are free from government regulation and the consumers get to choose the electricity service provider: this feature is presumed to enhance the efficiency of the market mechanisms. The wholesale electricity prices are determined by market forces within markets administered by KOREM.

The allocation of regulatory powers to different ministries and the presence of multiple layers in the governance structure could lead to delays in communication and concurrence and to less effective coordination. The ministries are required to work with common data and analysis to ensure efficient decisions are made by each of them. The existence of an interconnected governance structure provides for clarity of the demand and supply to be met and the tariffs regulation is significantly dependent on the availability of the resources and possibility of transmission of electricity to different parts of Kazakhstan. There is some overlap in the regulatory activities of the same market participants. For example, the regulation of electricity and capacity tariffs for thermal power plants—which are limited by maximum values specified—is carried out by the Ministry of Energy,

while the tariffs for heat supply are regulated by the Committee on Regulation of Natural Monopolies and Protection of Competition (KREMiZK) under the Ministry of National Economy. In order to provide social justice in the provision of ensuring heat supply, KREMiZK implements a policy of restraining tariff increases for end consumers, which results in unreasonably suppressed tariffs for thermal energy.

3. Legislative framework

Kazakhstan's parliament reviews the policies developed and proposed by the government and enacts laws accordingly. The president retains the status of supreme arbiter who regulates relationships among the legislative, executive, and judicial branches of government, and also of addressing issues pertaining to national security and defence capabilities. The various laws related to the energy sector in Kazakhstan are discussed in this section.

The Law on Supporting the Use of Renewable Energy Sources of Kazakhstan (2009) offers regulations for use of renewable energy sources in Kazakhstan, provides for the role and powers of the state regulatory authorities, and functions relating to the implementation of the state policy. The law also includes regulations relating to the 'obligations of participants in the production, transmission, and purchase of electrical energy produced by facilities for the use of renewable energy sources and secondary energy resources, facilities for energy waste disposal.'[53]

In 2012, the government of Kazakhstan launched the 'Kazakhstan 2050 Strategy,' which defines the course for long term economic development and also to place the country among the top 30 nations by 2050. This development focuses on reaching new export markets, improving the investment climate, and further developing the private sector and public–private partnerships. In May 2013, the government adopted the green economy concept, which advocates the ambitious goal of 50 percent generation of electricity from sources other than coal or oil—such as gas, nuclear, and renewable energy—by 2050. The government aims to achieve this by phasing out ageing infrastructure, increasing the use of alternative fuels, installing more RE technologies, and complying with high environmental standards.

In 2014, the Concept for the Development of the *Fuel and Energy Complex* of the Republic of Kazakhstan until 2030 was developed and approved, which links the development of the oil and gas, coal, nuclear and electric power industries, taking into account the best world experience and the latest trends in the development of world energy. The following priorities were laid down:

- Ensuring the energy security of the country, by strengthening the self sufficiency of providing resources and products of the fuel and energy complex.
- Strengthening geopolitical influence in the region, by satisfying the growth of energy consumption by the economies of the region.
- Developing the economic potential of the country: development of scientific potential, introduction of new technologies, improvement of safety and reliability of electrical equipment and power facilities.
- Intensively developing the fuel and energy sectors through the use of technologies of the 21st century: active involvement in the energy balance of renewable energy sources and alternative energy sources, energy and resource saving, energy efficiency.

In 2015, the 100 Concrete Steps programme was launched to bring about structural reforms to boost transparency and accountability. This was to be done by:

- Creating a professional government apparatus
- Ensuring rule of law
- By improving industrialisation policy and promoting growth

These reforms included privatizing agricultural lands to encourage their efficient use; optimising customs and tax policies and procedures; integrating customs and tax systems; introducing a 'single window' principle for customs procedures for exporters and importers; privatizing state monopolised examination of predesign and design documents; simplifying the legalization procedure for property and money; and replacing outdated construction standards and rules with the eurocodes system.

4. Private investment and grievance redressal for investors

As part of the 100 Concrete Steps program, the Astana International Financial Centre (AIFC) was opened in 2018 to promote private investment. The government has also introduced several reforms to support a favorable investment climate. The reforms include: rules for establishing a one stop shop for investors adopted in February 2015, and the amendment of Law on Investments in December 2014, supported by a liberalized visa regime.[54]

Kazakhstan is the front runner among the Central Asian countries in power sector reform. As of 2019, it was reported that 97 percent of all power plants in Kazakhstan were privately owned. The suppliers in the electricity market of Kazakhstan consist of power supply companies (PSC) which are involved with the purchase of electricity from generators or at the centralized auctions and further sell it to the end retail consumers. The auctions are regulated by JSC KOREM. Kazakhstan's capacity market has been functional since January 2019. As per the Law on Electric Power Industry, the capacity market was introduced to 'attract investments to support the operation of existing capacities and commissioning of new generation to meet the demand for electric power.'

In 2016, Kazakhstan's judicial system was converted to a three tier system (first, appeal and cassation) and the new Code of Civil Procedure became effective force. Kazakhstan plans to generalise the judicial practice of investment disputes to provide comfort to international investors. Similarly, in matters of administrative and criminal humanization of legislation, it plans to apply penalties and reasonable deadlines for their payment.[55]

5. RE sector development and observations

The first Law of the Kazakhstan Republic that aimed at supporting renewable energy was adopted in 2009, and the institutional and legal framework for RE development has significantly improved since that time. The National Concept for Transition to a Green Economy (2013) provides a roadmap[56] to increase the share of RE (and nuclear power) to 3 percent by 2017, 30 percent by 2030, and 50 percent by 2050 ('the Concept 2050'). The Law on Supporting the Use of Renewable Energy Sources (2013) laid out the feed-in tariff (FiT) for a 15 year period spanning 2013 to 2028 for electricity generated from solar PV, wind farms, geothermal power plants, from plants using biomass fuels and

from hydropower plants up to 35MW in installed capacity. The incentives also included subsidies of up to 30 percent of the costs associated with land acquisition, construction, and equipment purchases. A special green economy council was created within the Ministry of Energy to foster the development of RE in Kazakhstan.

The National Development Plan of the Republic of Kazakhstan (2018) fixes a target for the share of RE capacity to 6 percent by 2025. This document for the development of the waste management system and attracting investment in the waste processing industry provides for the introduction of waste disposal using 'waste to energy' (WtE) technology. When choosing and implementing new technologies, energy efficient, and 'smart' technologies recognized abroad were to become a priority for the country. If policies were implemented as planned, the volume of clean energy is to be doubled with the construction of 13 hydroelectric power plants, 34 wind farms, and 12 solar power plants.

The Financial Settlement Centre (FSC), a body within the Kazakhstan Electricity Grid Operating Company JSC (KEGOC), is the guaranteed off-taker and sole purchaser of electricity produced from renewable energy facilities. FSC carries out financial settlement of imbalances from RE facilities. Until the introduction of an auction mechanism in 2017, a local currency denominated feed-in tariff was applied to electricity produced from RE sources. The prices applicable to individual projects were set through auctions held in 2018 and 2019.The feed-in tariffs are subject to annual indexation: 70 percent for inflation and 30 percent for foreign currency exchange rate variation. The tariffs set through auctions are also subject to annual indexation: 30 percent for inflation and 70 percent for foreign currency exchange rate fluctuation. Subject to certain conditions precedent, the Commercial Code of the Republic of Kazakhstan provides for regulations relating to investment schemes and to exemption from tax duties and value added tax on imported equipment, as well as on grants (state land), subject to the fulfilment of certain conditions.[57]

More recently, several RE projects had been built and commissioned in the country. As of October 2021, an estimated 117 RE projects were operating in the Republic with a total capacity of 1,705MW, broken down into wind energy (496.3MW), solar PV (971.6MW), hydropower (229.28MW), and biogas (7.82MW). The electricity generated by these RE projects as of the end of 2020 was about 3.24 billion kWh. By the end of 2021 about 23 additional RE projects[58] were to be commissioned, potentially adding 381.1MW in installed capacity. On average, annual electricity production in the country is reported to have grown at a rate of about 2 percent between 2015 and 2020, while demand is projected to have risen at a rate of 3 percent each year. Given Kazakhstan's economic growth projections, electricity demand is expected to reach 136 billion kWh by 2030 and 172 billion kWh by 2050.

The Ministry of Energy in Kazakhstan develops an annual auction schedule for the construction of RE projects, with a capacity of approximately 250MW to be tendered during the average year. The annual bidding of 250MW allows for the systematic development of the RE market and attracts investments as appropriate: 50 RE power plants with a total installed capacity of more than 950.46MW sell electricity through 'SFC' for RES LLP.[1] These include: the largest solar power plant SES

[1]In pursuance of the Order of the Minister of Energy of the Republic of Kazakhstan dated 31 March 2015 No. 256 'On Determining the Settlement and Financial Center for the Support of Renewable Energy Sources' and the Order of the Minister of Energy of the Republic of Kazakhstan dated 7 September 2018 No. 357 'On Determining a Single Purchaser,' the Board of

'SARAN' in the Karaganda region (100MW), the largest wind power plant—CATEC Green Energy LLP in Nur-Sultan (50MW)—and a HPP on the Kora River (Almaty Oblast) with a capacity of 28.5MW.

6. Energy efficiency

Kazakhstan, with a RISE score of 70, has the highest energy efficiency score out of all countries covered by the study, ranked after China. The regulatory framework on energy efficiency in Kazakhstan covers 10 areas from 11:

1. National EE planning
2. EE entities
3. Incentives and mandates: industrial and commercial end users
4. Incentives and mandates: utilities
5. Financing mechanism for EE
6. Minimum EE performance standards
7. Energy labeling systems
8. Building energy codes
9. Transport sector
10. Carbon pricing and monitoring

The main document on energy efficiency is the **Law No. 541-IV on Energy Saving and Energy Efficiency (2012).** This law has provisions on energy efficiency classes (labels) for new and existing buildings, energy management, and auditing. Buildings consuming more than 350 tons of oil equivalent (toe) shall be subject to mandatory energy saving and energy efficiency analysis. Buildings are classified from 'A' to 'E' EE classes (with 'A' being the most energy efficient building category). The minimum energy performance standard[59] for new building design is set at the level of class C. Energy management and audit in industries is mandatory for large consumers and auditing procedures must follow the international standard ISO 50001. Large consumers are mandated to report energy consumption to the National Energy Register (NER) that serves as the national energy database.[60]

The Electric Power and Energy Saving Development Institute is responsible for promotion of energy efficiency and effective implementation of policies. It is a state owned enterprise and a subsidiary of the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan. With the government strategy 'Kazakhstan 2050,' the government introduced a new political course enhancing the country's transition towards a 'green economy.' The green economy is defined as 'an economy with a high quality of life and sound and sustainable use of natural resources in the interests of current and future generations.' It focuses on raising the share of renewable energies, decreasing the GDP energy intensity, providing drinking water for all, and increasing agricultural productivity. Kazakhstan 2050 also set the overall goal to reduce the energy intensity of the GDP by 25 percent to 2020, by 50 percent to 2050 compared to the level of 2008.

The Law on Energy Savings from 2012 pointed out that the ministry should develop MEPS and energy labeling for major electrical appliances in household and industries. Up until October 2021, no such standard was yet in place. However, the government is working with the UNDP towards market transformation since 2017 under the project 'Energy Efficient Standards, Certification, and Labeling for Appliances and Equipment in Kazakhstan.'[61] The project developed a policy recommendation on national MEPS and a draft law on EE standards and labeling for electric motors, transformers, and refrigerators.The Law on Energy Savings outlines seven energy efficiency priorities which have a strong focus on EE in industry, reduction of energy and heat losses, EE capacity building,

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Directors of KEGOG JSC decided to establish a limited liability partnership 'Settlement and Financial Center for Support of Renewable Energy Sources' ('SFC' for RESLLP).

public awareness raising, and reducing fuel consumption of the transport sector. However, quantitative goals for priorities were not reported.

The Energy Efficiency 2020 Program sets specific policy targets, mostly in terms of energy or cost reduction. The policy analysis reveals that the regulatory framework for energy efficiency in Kazakhstan is complex and has many policy documents, strategies, plans, and laws. The 'pyramid' shows the five main legal documents (on the bottom) and key priorities and planned action defined by the government.

Kazakhstan has succeeded in the early stages of developing EE regulations and plans for the country. Pilot programs such as an energy efficient lighting program and the retrofitting of district heating systems show that energy saving potentials are high. However, two persistent and overarching barriers are hindering replication—a low energy tariff and aggregated metering that does not incentivize investments in energy efficiency; and limited availability of capital for energy efficiency projects.

7. Review of the framework in Kazakhstan

- **The Renewable Energy Law remains silent regarding the transmission of power to other countries during times of lower demand and higher supply in Kazakhstan.** The mechanism for trade of power with the neighboring countries, and the possibility of tariff determination for the said transmission is not specified within the RE Law. The inclusion of these regulations and empowering a specific agency to determine the quantum of international trade and the pricing mechanism might expand the scope for trade as well as increase the efficiency of asset use, and ultimately facilitate cost reduction.

- Reporting requirements are also significant compliance trackers to analyze and understand the existing utilities and their capacities. The information relating to realtime performance of the RE projects in Kazakhstan through such reporting data provides continuous assessment of the existing regulatory measures in comparison with the ideal practices prescribed/to be prescribed for further improvements in the energy sector. The scope of functions of the RE sector of Kazakhstan may require the inclusion of the aforesaid aspects to utilize the opportunities available for RE deployment.

E. KYRGYZSTAN

1. Overview of the power sector

Kyrgyzstan is home to wide mountain range cover and is a landlocked country bordered by Kazakhstan, Tajikistan, Uzbekistan, and China. Kyrgyzstan enjoys large endowments of water resources and the potential for abundant supply of hydropower. It is believed that a mere 3 percent of the total potential offered by its 252 rivers was being exploited.[62] In addition, the country receives about 2,600 hours of sunshine per year and radiation is 1,500kW/m^2 to 1,900kW/m^2 per year,[63] yet solar PV projects are projected[2] to operate at or below 16 percent efficiency (PLF: plant load factor). As a result, more than 90 percent of domestic electricity is derived from hydropower, which also means and implies lower generation in the winter, which leaves the country in a deficit during the colder months when the demand for space heating is at its peak. The years when water availability is low and the months of the year when generation is lower than demand, the country is compelled to import electricity from Tajikistan and Kazakhstan.[64]

Of the nine state owned power plants, seven are hydropower stations, including the 1,200MW Toktogul hydropower plant (HPP) on the Naryn River, which during an average year accounts for about 40 percent of the country's power output. The Toktogul project is owned by the Open Joint Stock Company Electric Power Plants (EPP). The plant also enables exports to the neighboring countries during summer and until recently the plant had provided frequency regulation support to the entire Central Asian power system. Refurbishing the ageing components of the project originally commissioned in the 1970s commenced in 2012 and the upgrade project is expected to add 240MW to the generation mix by 2023; in addition to supplying domestic consumers, this upgrade was projected to provide for additional power exports during the summer as well. Among others, these upgrades were funded by the ADB through loans and grants and the Government of Kyrgyzstan, and the Eurasian Fund for Stabilization and Development.[65]

In April 2019, the Eurasian Fund for Stabilization and Development (EFSD, Fund) managed by the Eurasian Development Bank committed USD110 million in investment credit to construct and commission the 120MW Kambarata HPP 2 project.[66] In November 2019 the Kyrgyz Government and the ADB executed the agreements for a USD100 million package—USD60 million in loan and USD40 million in grant—to modernize and upgrade the Uch-Kurgan HPP along with the Naryn river cascade. The Eurasian Development Bank had committed USD45 million for the project.[67] The installed capacity was to be enhanced from 180MW to 216MW. As of October 2021, the Kok Sai and the Konur-Olon small hydropower plants discussed within the case study further below and a few others had been operational while new plants aggregating in excess of 100MW were at various stages of design and implementation.[68] The two thermal power stations, in Bishkek and in Osh, are used primarily for residential space heating. A new 1,200MW thermal power plant has been under construction at the Kara Keche coal deposit. In 2017, the Kyrgyz Government announced tenders to upgrade and expand the generating capacity at four small hydropower plants across the country.[69]

The energy sector in Kyrgyzstan is considered 'strategic' and important to assure the wellbeing of the population and to support the growth of industry. The installed electricity generation capacity in Kyrgyzstan stood at about 3,940MW in 2020, comprising approximately 3,100MW of hydropower

[2]Estimates made as a part of the present research effort

and about 800MW of fossil fuel capacity. The average annual output from such capacity, however, at 14.7 billion kWh, represented low efficiency of asset use (approximately 43 percent), largely owing to the very low productivity of the fossil fuel capacity and the low productivity of hydropower projects during the winter months. Reportedly, the unused reserve is of the order of 2,240MW in capacity. Upward revisions of end use tariffs might be necessary to provide for upgrades to the generation assets and for the modernization of grid network assets, and yet such increases might leave negative impacts on sections of society, at least in the short run.

Kyrgyzstan is a part of the Central Asian Power System that connects Uzbekistan, Kyrgyzstan, Tajikistan, and Kazakhstan. New integration plans like the Central Asia–South Asia power project (CASA-1000) have been formulated: these projects are slated to connect the electricity exporting countries like Kyrgyzstan and Tajikistan with importers like Afghanistan and Pakistan to supply them with electricity. Such links are projected to commence operations after 2023.[70]

2. Principal agencies and institutions

Prior to 2014 both policy and regulatory functions were under the **Ministry of Energy and Industry** of Kyrgyzstan. In 2014, with the support of development partners, the Government—as part of the implementation of the Energy Sector Reform Action Plan for 2013-2014—approved the establishment of the independent regulator in the power sector: the **State Agency for Regulation of the Fuel-Energy Complex (SARFEC)**. SARFEC[71] was established to facilitate licensing of the activities of the energy sector, for developing tariff methodologies and setting tariffs for electricity, heating and natural gas. SARFEC was also responsible for developing and supervising the reporting and monitoring framework of the companies in the energy sector, for organizing awareness creation/rising activities and for developing strategies to address consumer and sector company claims and complaints.

In 2015, the Ministry of Energy and Industry was abolished. The functions of formulation of policy framework and development strategies for fuel and energy were transferred to the **Ministry of Economy** in 2015 and after that was entrusted to the **State Committee on Industry, Energy and Subsoil Use** in 2016. In 2021, the Ministry of Energy and Industry was re-established. Also in 2021 SARFEC was transferred back to the Ministry of Energy and Industry of Kyrgyzstan in terms of the new country leadership's policy of streamlining state bodies.

The **Kyrgyz Electricity Settlement Center (KESC)** was established in 2016, with an intention to improve the transparency in revenue flows of the power sector. The Government approved the establishment of **National Energy Holding Company (NEHC)**, an Open Joint Stock Company (OJSC). Yet, the NEHC did not operate independently, but worked merely as a vehicle, and the key responsibility of its functionaries was to serve on the boards of directors of the subsidiary companies. The boards of directors of the subsidiary companies approved strategies, set targets, defined performance indicators, and proceeded to monitor progress in the sector. NEHC also conducted internal audits; such audits were previously conducted by the subsidiary companies, prior to the establishment of NEHC.

The Ministry of Energy and Industry develops and implements a unified state policy in the field of fuel and energy complex and in ensuring energy security for the country. It is in charge of the strategy, programs, plans, and agreements for efficient development of the sector and undertakes the following functions:

- The Ministry develops incentive mechanisms for energy efficiency, energy saving, and renewable energy use
- Acts on behalf of the state as a shareholder management body in the open joint-stock company National Energy Holding Company
- Carries out state regulation of activities of fuel and energy complex entities through licensing and tariff setting for electricity, heat, and natural gas

3. Legislative framework

Kyrgyzstan adopted the Renewable Energy (RE) Law in 2008. The RES Law has been amended multiple times in order to initiate the development of a RES market in Kyrgyzstan, but progress has been impeded by the lack of by-laws, both in relation to generation and supply activities and on land related issues, and the fact that premium payments for RES-generated electricity were loaded on to the costs of already loss-making distribution companies in the energy sector. In 2016, a draft *Concept for Fuel and Energy Complex Development* until 2040 was developed, but was not approved by the Government of Kyrgyzstan.

The Medium Term Tariff Policy (MTTP) 2014-2017 was developed under the principles of cost recovery for the sector; end user tariffs were raised by 2018. However, the implementation of MTTP 2014-2017 was not entirely consistent with the original vision of the MTTP. A 'two tiered' residential tariff was introduced to benefit the lower income consumers and a higher tariff was imposed on additional (higher) consumption. These tariffs were beneficial to the electricity utilities but the tariffs were not in line with the stipulations of the MTTP 2014-2017 which had proposed a 'steadily increasing and predictable tariff path for heating and electricity services.'[72] At the same time the tariffs have not enabled energy companies to meet their loan repayments, which by some estimates exceeded USD1.5 billion in 2021.

Despite the frequently highlighted need for raising tariffs to levels that would be consistent with recovering the total cost of generation and distribution, it is also believed that increasing tariffs would affect different segments of the population differently. For instance, increasing tariffs for thermal power used for central heating and for heating water would affect the richer households in urban areas. Removing the subsidies[73] on electricity supply was projected to reduce real incomes by about 6 percent and an increase in poverty of about 3.2 percent.

The National Development Strategy of Kyrgyzstan for 2018-2040 (2018) envisages a shift to the use of 'high quality' fuel in combination with expansion of the use of alternative energy sources as a priority. At the same time, it is essential to diversify sources of energy for the needs of the national economy. In March 2020, the government approved the Medium Term Tariff Policy (MTTP) for 2020-2022 to make electricity, heating, and hot water tariffs more cost reflective to help with cost recovery while providing affordable energy for the most vulnerable customers.

4. Private investment and grievance redressal for investors

Regulations that allow for preferential treatment for investors engaging in the production and generation of electricity using RE options have been adopted. RE projects are exempt from value added tax (VAT) on imported equipment, and from income tax for up to five years. They are assured of a guaranteed repurchase of generated electricity, (taking into account an increasing coefficient for

a preferential period of ten years) at 1.3 times the maximum electricity tariff in the country as long as the project was within the established quotas for the country's regions.

Kyrgyzstan has signed two conventions on international commercial arbitration: the Convention on Settlement of Investment Disputes between States and Nationals of Other States (the ICSID Convention), ratified by Kyrgyzstan in July 1997; and the Convention on Recognition and Enforcement of Foreign Arbitral Awards ('the New York Convention'), ratified in May 1995.[74]

5. RE sector development scenario and observations

According to the *Green Economy Concept of Kyrgyzstan* 'Kyrgyzstan is a green economy country' (2018). 'The development of green energy should be a priority, given the strategic focus on developing a green economy and ensuring energy security owing to the country's high dependence on imported oil products and natural gas.' The country aims to undertake policies to:

- Achieve reduction of energy losses through technical and institutional changes in the energy sector
- Prioritize the introduction of low carbon, renewable energy sources and improve energy efficiency
- Reduce state funding for environmentally harmful energy measures in the form of heat and electricity tariff subsidies
- Consider a complete rejection of design and construction of thermal power plants and boiler houses using coal as fuel
- Implement the planned large HPP construction projects while minimizing the negative impact of the construction of plants and associated reservoirs on the ecology of the respective regions
- Utilize the hydropower potential of small HPPs as much as possible for the development of the regions, especially given the heavy dependence of large HPPs on low water cycles
- Quantify RES potential (small HPPs, solar systems, wind and biogas plants) for each district of Kyrgyzstan with the involvement of scientific and private specialists
- Develop legislative initiatives to encourage the development of distributed energy production from individual RES installations (small HPPs, solar systems, wind and biogas plants) and energy exchange to reduce grid losses and grid load
- Develop a vision, strategy, and plan for energy sector development until 2040, taking into account the country's commitment to the sustainable development goals to increase the share of RES (small hydropower, solar systems, wind and biogas) to 10 percent of total electricity generation
- Introduce a balanced tariff policy for electricity and heat that provides flexibility in meeting demand and covers the costs of energy producers, including considering the introduction of a differentiated electricity tariff in winter
- Continue the gradual and steady conversion of boilers and individual heating of private sector households to natural gas using new energy efficient gas boilers
- Develop competition in heating systems in the cities and abandon monopolistic dependence on one heat supplier
- Develop individual energy saving and energy efficient electric and gas heating, including the use of solar collectors for heating and hot water
- Encourage the introduction of biogas production technologies from domestic and municipal organic waste and sewage

- Establish a Central Asian green energy development center
- Introduce energy saving and energy efficiency measures in enterprises generating, transmitting, and distributing electric and thermal energy
- Introduce energy saving and energy efficiency measures for the end users of electricity and heat (enterprises, agencies, private consumers)
- Application of new building standards and implementation of energy efficiency measures in the construction and heating sectors for the construction of new green residential and public buildings, as well as implementation of energy efficiency renovation measures in old buildings
- Widespread introduction of flow and metering devices for electricity, heat, gas, and water consumption
- Transfer of street and house lighting to energy efficient lamps, awareness raising activities among population on comprehensive insulation of housing for energy saving
- Development of a national energy saving program, including a program for the insulation of old housing as the main instrument of the state energy saving policy

However, it should be noted that there is no action plan and no concrete mechanisms for achieving the set objectives.

The recent changes to the RE Law, introduced in July 2019, provided for:

1. Compensating distribution companies for the additional costs of purchasing electricity generated from RE sources, and such premiums would be taken into account when calculating and setting the national end user electricity tariff.
2. Revision of the increasing coefficients to the maximum tariff at which RES electricity will be purchased: as of October 2021, the coefficient is 1.3 for all types of RES, which primarily promoted the development of small hydropower plants only.
3. The introduction of RES capacity ceiling: the determination of the total electrical capacity of RES installations by region and by RE source, by an authorised state body, for the projects to receive a premium tariff for a fixed period of time.

Until now, the absence of detailed by-laws regulating the legal relations of RE project entities and the transmission and distribution utilities and other agencies, the inadequate definition of procedures and responsibilities of each RES market participant hampered implementation of the law and caused many problems for investors (see case study below) leading to economic losses for investors and resulted in the low investment attractiveness of the sector.

In order to eliminate the gaps, the regulation 'On the Conditions and Procedure for the Performance of Generation and Supply of Electricity Using Renewable Energy Sources' (2020) has been approved.

Within the framework, the regulation:

1) Defines the subjects of RES as natural and legal persons, foreign natural and legal persons, individual entrepreneurs who have expressed their intention and/or are carrying out activities in the production (all types of regime), supply (sale) of electricity generated using RES.
2) Defines conditions and procedures for implementing activities on generation and supply of electricity using RES and regulated legal regimes of activities on generation and supply of

electricity using RES within established quotas, outside quotas, on a contractual basis and for consumption for own needs.

3) Defines a mechanism of interaction among all participants involved in the process of generation and supply of electric power with the use of RES—authorized state bodies, local state administrations, local self government bodies, and subjects of RES—to delineate their responsibilities and to increase responsibility in terms of compliance with the rules and procedures providing for the procedure of electric power supply and fulfillment of contractual obligations on electric power supply with the use of RES.
4) Defines the role, rights, and obligations of each of the participants, which are also defined in the regulation.

In order to obtain the premium tariff and other incentives on offer, a procedure for inclusion of RES subjects in the state register of RES subjects is envisaged. The inclusion in the register of RES subjects—an official source confirming the legal status of the RES subject—and the issuance of an official document (certificate) solves the issue of securing and confirming the legal status of the RES subject. The register of RES subject is also required to ensure the evaluation and statistical accounting of electricity generated by RES.

The regulation also describes in detail the four legal regimes and stages of the activity of generation and supply of electricity using RES:

- Supply of electricity using RES within the limits of quotas/ceilings
- Supply of electric energy with the use of RES outside the quotas
- Supply of electric energy with the use of RES on a contractual basis
- Generation of electric energy using RES for own needs

In addition, the RES subjects are entitled to claim a tariff preference for a grace period within the capacity quotas established by the authorised state energy policy making body.

A tariff preference in the amount of the maximum end user tariff (2.24 soms), with the application of an increasing coefficient (1.3) for a grace period (not exceeding ten years), within the capacity quota, is granted to persons included in the register of RES entities. Capacity within the quotas is allocated according to the 'first submitted application' rule—that is, in the order of filing an application for a tariff preference. After exhausting the installed capacity quota and/or when constructing an energy RES plant outside the quota framework, and when supplying such surplus electricity to the distribution companies' networks, the RES project is paid a tariff for the RES electricity it generates at the level of the maximum end user tariff (2.24 KGS), less the transit service cost of the electricity company (varies by distribution companies), subject to a payback period set by GARTEC (not exceeding eight years).[75]

By 2018, the government had also proposed creating a system of economic incentives to reduce energy use intensity while expanding the green economy and reducing environmental pollution. In 2019, Kyrgyzstan joined the Regulatory Indicators for Sustainable Energy (RISE), a World Bank supported initiative that helps with policy making and identification of the reference benchmarks for sector policy and regulatory frameworks against those defined by peers.

6. Energy efficiency

Kyrgyzstan scored 51 points on the World Bank RISE scale, which is lower than the global average of 61, with the energy efficiency specific score of 26.
The regulatory framework on energy efficiency in Kyrgyzstan covers seven areas:

1. Energy efficiency entities
2. Incentives and mandates: industrial and commercial end users
3. Incentives and mandates: utilities
4. Financing mechanism for EE
5. Minimum EE performance standards
6. EE labeling systems
7. Building energy codes

Energy supply and demand offers many opportunities for efficiency improvement in Kyrgyzstan. Energy supply infrastructure is depreciated and therefore highly inefficient with distribution and transmission losses estimated at 18 percent of input energy (in 2019). Most of the household and commercial buildings were constructed during the Soviet era with low insulation efficiency standards. In recent years, several project and financing schemes were introduced to enhance EE investment and retrofitting in the building sector.

The core regulation for energy efficiency is the *Law on Energy Savings* (1998). In March 2013, a Law on Energy Conservation and Energy Efficiency in Buildings was adopted. In 2015, a State Program on Energy Saving and Energy Efficiency Policy Planning for 2015-2017 was approved to enhance energy efficiency of buildings through improvement of their thermal performance, cost efficient EE measures, and reduced energy consumption.

The Decree of the Kyrgyz Government No. 255 ('On approval of the limit of consumption of heat, electric energy, natural gas, water, and sewage for 2005-2006 for budget organizations and measures on rational use of funds allocated to budget organizations for payment for public utilities') introduced the concept of a standard energy passport of the organization and the technical passport of the boiler plant.

According to the Law of Kyrgyzstan on Energy Savings, 'Energy passport is a technical document reflecting the normative and actual state of the energy economy of enterprises, regardless of ownership forms.' The energy passport is drawn up based on the results of the energy inspection of organizations in order to assess the efficiency of fuel and energy use and reduce consumer spending on fuel and energy.

The most important public institution for EE in Kyrgyzstan is the Ministry of Energy and Industry. It is responsible for developing regulation and incentives for energy efficiency, energy saving, and the use of renewable energy sources, as well as creating conditions for introducing and using renewable energy sources and reliably supplying consumers with energy resources, industrial products and services. The State Agency of Architecture, Construction, and Housing and Communal Services under the Ministers Cabinet of Kyrgyzstan is responsible for the implementation of energy saving and energy efficiency policy in the construction and building sectors.

The Program for the Development of a Green Economy in Kyrgyzstan for 2019-2023 sets the following policy targets related to energy efficiency:

- Energy intensity of GDP reduced by 10 percent by 2023
- Energy consumption in residential, public, administrative, multifunctional, and non-production buildings reduced by 10 percent by 2023
- Energy transmission and distribution losses reduced to 12 percent by 2023
- Commercial losses eliminated by 100 percent
- A medium term tariff policy was developed and implemented for 2018-2023, ensuring breakeven in the energy sector
- By 2023, private investment in the energy sector increased by over USD300 million

Kyrgyzstan has taken the first steps towards setting up a comprehensive regulatory framework to achieve energy savings in major economic sectors. Several institutions have been mandated to lead the actions. Energy retrofitting pilots in the building sector showed the waste amount of savings that could be achieved. The government set quantitative energy saving targets through to 2023 for reducing the energy intensity and the energy use in residential and public buildings. As of 2021, the country had not defined energy efficiency standards and labeling for household and other electrical appliances. Likewise, specific policy plans or actions to enhance energy efficiency in the industrial sector were not in place.

The government has started encouraging EE in industry by providing a reduction in customs rates for imported EE equipment and preferences for investments in EE projects. The sharp increase of 68 percent in the electricity tariff for industrial consumers in August 2015 was a major step to make EE investments more attractive. Government is yet to designate an authority responsible for setting up and operating an energy audit scheme.[76]

7. Review of the framework in Kyrgyzstan

- Over the years, tariff policy making has had to grapple with the dilemma of determining tariffs at levels compatible with recovering costs of generation and service delivery, while also ensuring positive public sentiment. This could be potentially addressed through a supervisory body focusing on energy policy working in close conjunction with an economic scheme of transfers for the vulnerable sections of society. As discussed in the small hydropower project case study, in the absence of such policy measures to strike a balance between the viability of utility operations and simultaneously protecting the vulnerable sections of society, the utility companies might have little incentive to draw power from RE projects in the country.

- As a part of the effort to optimize regionwide supply to meet regionwide demand projected for 2030, the present study has recommended the addition of 1,500MW of wind energy generation—operating close to 33 percent PLF on average over the year, and using up all the presently estimated wind energy potential in the country—in an effort to replace fossil fuel capacity in the region. This suggested addition of wind energy generation capacity would have to be made in addition to the business as usual growth in hydropower capacity in the country and in addition to relatively minor additions to solar PV, biomass/biogas capacity through to 2030.

F. MONGOLIA

1. Overview of the power sector

Mongolia is located between two of the largest countries on the planet, Russia and China. Consequently, in regions of Mongolia adjoining Russia and China, electricity is imported from across the border. As of 2020, an estimated 45 percent of the 3 million population of Mongolia resided in and around the capital, Ulaanbaatar. The energy sector in general and the electricity sector in particular are shaped by these unique circumstances. In 2018, coal fired plants and diesel generators dominated power generation in the country with 92.6 percent of 1,550MW installed capacity running on fossil fuels.[77] By 2020, the generation capacity included some 31MW of hydropower, 156MW of wind energy, and 90MWp of grid connected solar PV capacity. Despite this addition in capacity, Mongolia has remained among the lowest electricity consumer countries in the CAREC region second only to Afghanistan.

The power system in the country has five isolated segments: Central Energy System, Western Energy System, Altai-Uliastai Energy System, Eastern Energy System, and South Gobi Region. The segments are based on geographic divisions, with Central Energy System being the largest one with an installed capacity of 1,166MW (around 75 percent of the country's installed capacity). Seven of the eight coal fired plants in the country are located in this region. The central region also imported 1,200GWh (15 percent of its consumption) from China and 176GWh from Russia. The region also exported 54GWh of electricity to Russia in times of surplus generation. Overall, *circa* 2019 the country imported about 20 percent of its domestic electricity demand.[78]

The power grid is reported to have been built in the 1960s and lacks the flexibility to connect decentralized sources of electricity generation.[79] It is estimated that Mongolia's unified energy system might absorb a maximum of about 30 percent of electricity from variable sources. This capacity aligns with the government's target[80]of increasing the proportion of RE sources within the total installed capacity to 30 percent by the end of 2030. The bulk of the north and west part of the country is covered with mountains and grassy steppes. The southern part of the country hosts the Gobi Desert. Hence, it has huge potential for exploiting both solar and wind energy resources. The potential of solar PV deployment is estimated at 1,500GW, and for wind energy generation at 1,100GW. Further, the potential for extracting hydropower from the country's 3,800 water streams and rivers is estimated to be 6.4GW. Potential for geothermal power has also been confirmed with the identification of some 43 geothermal reservoirs located across the country.[81]

2. Principal agencies and institutions

The **Ministry of Energy (MOE)** is responsible for policy making for the energy sector and the policy development process covers the development of energy resources, construction of power plants, building grid networks, and the use of RE technologies. It is also responsible for maintaining international cooperation.

The country's *Energy Law* was adopted in 2001, and an independent regulatory body, the **Energy Regulatory Agency (ERA**), was established in the same year. The 'single buyer' model was adopted in 2002. In this model, a single buyer—the Central Regional Electricity Transmission Network—purchased electricity from five power plants operating in the region and through imports from

Russia and sold it to ten electricity distribution companies. Because of the single buyer model, sales revenue collection improved from 76.5 percent in 2001 to over 100 percent in 2011, reducing the debts accumulated from the previous years.[82]

In December 2011, the law was amended to reorganize ERA and it was named the **Energy Regulatory Commission (ERC).** The amendment was made to commence the transformation of the energy sector in Mongolia into a market driven system. The powers granted to ERC under the amendment included the determination of tariffs for consumers and approving the tariffs for licensees. The commission was also responsible for determining terms and conditions for the license and for monitoring compliance by the licensees. Further, the Commission was tasked with deciding on the investments required for transmission and distribution networks, and with defining the tariffs to meet such requirements. The licenses are issued for various types of requirement in the energy sector: electricity generation, transmission and distribution, importation and exportation of electricity and supply of gas.

3. Legislative framework

The legal framework of Mongolia comprises laws for energy, licensing, renewable energy (RE), foreign investment, concessions, and energy conservation (EE). The Renewable Energy Law, approved by Parliament in 2007, was adopted to regulate relations relating to the generation of electricity using RE technologies and delivery of such electricity.

The end use tariffs in the country differ by electricity consumer segment and by region. For instance, the central and southern regions have different types of tariff—single use tariffs and time-of-use tariffs. Time-of-use tariff varies by shoulder, peak and off-peak hours. Residential and industrial users pay different tariffs from household consumers. The tariffs for residential users are 'telescopic,' with households consuming below 150kWh paying 110.28 MNT/kWh and those consuming above 150kWh paying 130.08 MNT/kWh. The tariffs include an RE levy of 11.88 MNT/kWh. A similar tariff structure exists in Altai-Uliastai and eastern regions. However, the eastern region does not include any renewable energy levy in the tariff, and hence the region has lower tariffs than the other regions.

- The transition towards sustainable electricity will also entail socioeconomic benefits in creating sustainable jobs in future oriented sectors like low carbon electricity generation.[83]
- The introduction of low carbon technologies to effectively decouple the electricity and heat supply in Mongolia can positively impact public health owing to a lasting reduction in local air pollution levels.
- The present study recommends the addition of some 10,620MW of wind energy generation by 2030, operating at an average efficiency of about 33.7 percent, to contribute to replacing fossil fuel fired generation in the region. This capacity addition would be incremental to the business as usual growth in capacity from hydropower and other non-fossil technology options.
- Since the RE sector is relatively nascent in Mongolia, growth in the sector is limited by the availability of skilled manpower. Hence, the agencies concerned need to develop requisite institutions to build such capabilities.
- Policy makers need to actively manage a just transition for those communities affected by the reduction of coal related jobs, given the uncertain future for coalmining jobs in the country.

- In expanding the grid network to cover larger sections of the population and to export power to other countries, adequate flexibility would be required to link variable sources such as wind energy generators and solar PV plants.

4. Private investment and grievance redressal for investors

The Ministry of Finance bears the responsibility for strategic planning for various sectors in the country sectors and also for the preparation and administration of the state budget. This includes encouraging private investment, such as public private partnerships, as a means to enhance GDP growth.[84] This readiness for private participation is demonstrated in the case study attached to this country profile. The Mongolian National Development Agency's *One-Stop-Shop for Investors* provides services relating to taxation, notarization, business registration, and visas.

Contractual disputes are resolved through the civil court division of the district court system. Disputants may appeal to the City Court of Ulaanbaatar and ultimately to the Supreme Court of Mongolia. The government has taken steps recently to ensure that threats to judicial independence are resolved by adopting constitutional amendments in 2019 and judicial reforms introduced in 2020 and 2021 to improve transparency while reducing political influence in the appointment and removal of members of the jury. Investors, however, continue to experience delays in reaching court judgments in business disputes, followed by similarly long delays in the enforcement of these decisions.[85]

5. RE sector development scenario and observations

The Ministry of Environment, Green Development and Tourism (MEGDT) is responsible for environment and green development and is also engaged in international dialog and events related to climate change by developing government policies and strategies on climate change, and enforcing legal requirements for the protection, conservation, and appropriate use of natural resources. It is also concerned with improving soil, water, and forest resource management, strengthening environmental monitoring networks, conducting necessary research and sharing information about the environment to individuals and institutions and implementing climate change related projects using internal and external funding and coordinating the actions of multiple agencies involved.[86]

To encourage renewable energy in the country, the government has exempted most RE equipment from various types of tax and levy including value added tax (VAT), customs tariffs, and related charges. The Ministry of Energy for Mongolia has set a two phased plan to increase RE capacity through to 2030 and to export RE generated power post 2030. The second phase of the plan covering 2030 to 2040 includes deploying a smart grid to connect various regions in the country to supply electricity generated from renewable sources.

The *Gobitec Concept* was envisaged to produce clean electricity from solar and wind energy in the Gobi Desert and to supply the electricity produced to the markets including the likes of Russia, China, Mongolia, South Korea, and Japan through the proposed Asian Super Grid (ASG). The project aims to meet domestic demand and to export the surplus to other countries.[87] The project is similar to 'DESERTEC,' developed to deploy renewable energy plants in Middle and East African countries to meet domestic demand and export the surplus to Europe. The Asian Super Grid initiative was proposed to allow for a free exchange of electricity among the countries in northeast Asia to provide economic as well as environmental benefits.

6. Energy efficiency

The strong economic growth in Mongolia between 2008 and 2018 was accompanied by a corresponding increase in energy consumption in all sectors. Owing to the country's promising long term development prospects, such growth in energy demand is expected to continue. Mongolia scored 35 on the World Bank RISE scale and, to the country's credit, this score has increased by 2 points since 2017; at 34, the corresponding EE score for Mongolia was in the middle of the CAREC region countries.

The regulatory framework on energy efficiency in Mongolia covers seven areas:

1. National EE planning
2. EE entities
3. Incentives and mandates: industrial and commercial end users
4. Incentives and mandates: public sector
5. Incentives and mandates: utilities
6. Financing mechanisms for EE
7. Building energy codes

The increase in energy demand has highlighted the importance of EE in national planning: EE figures prominently in Mongolia's National Green Development Plan approved by Parliament in June 2014. The government intends to reduce greenhouse gas emissions from the energy sector through an increase in EE of 20 percent by 2030, while seeking to reduce building heat losses by 20 percent in 2020 and 40 percent by 2030. To operationalize these targets the *State Policy on Energy 2015-2030* was among the three major policy principles approved by the Government of Mongolia.

In 2015, the Parliament ratified the *Energy Conservation Law*, which intended to regulate activities related to energy conservation and efficient use. It has provided a legal framework to implement a policy aimed at improving the efficiency of energy use; introducing technologies that are environment friendly, highly productive, and efficient; and creating a culture of energy conservation.[88]

The Government of Mongolia set out ambitious targets and goals to reduce GHG emissions in the energy sector through developing RE and improving EE. Mongolia's Nationally Determined Contribution (NDC) proposes EE measures in both the energy and construction sectors as mitigation measures. Mongolia's NDC was approved by Government Decree No. 407 of November 2019, with the aim to contribute to the Paris Agreement: 8,340.5Gg CO2-eq are expected to be reduced by the improvement of the efficiency of energy production, including the measures to:

- Reduce electricity (and heat) transmission and distribution grid losses
- Reduce the internal use of combined heat and power plants (CHPP)
- Improve the efficiency of power plants
- Improve the heat supply in cities and towns (improving the efficiency of heat only boilers)

7. Review of the framework in Mongolia

- Mongolia might be well placed to serve as the CAREC region's RE powerhouse. The country could focus on diversifying away from coal fired plants and investing into programs that

developed the skilled manpower required for large scale RE deployment, especially exploiting the wind energy resource in the country.

- As the local personnel are acquainted with the terrain and the institutions, training them could result in expedited installation and disciplined maintenance of the wind power plants.

- Owing to its low temperature, the Gobi Desert could be a great source of solar PV electricity; hence, Mongolia could emerge as a significant RE producer owing to the Gobitec project. The proposed Asian Super Grid (ASG) could help export the power generated in this way to various parts of Asia.

G. PAKISTAN

1. Overview of the power sector

Among the CAREC region countries, Pakistan occupies a unique position given the largest electricity demand (not counting China), despite relatively low levels of energy security and constrained financial resources,[89] all of which call for precise optimization of energy resource application. Almost a third of the energy resources consumed in Pakistan are imported including oil, liquefied natural gas (LNG), and coal. Such dependence on imports contributes to energy insecurity while also exposing the Pakistani economy to energy price shocks and to the risk of domestic inflation from higher energy prices. Inflationary pressures leave negative effects on the competitiveness of the country's exports, which further constrains the country's capacity to import[90] fuels. Pakistan's power sector is also strongly influenced by 'circular debt,' creating a cashflow constraint for producers owing to non-payments by utilities which ultimately lead to protracted and unannounced load shedding.

It was estimated that the country faced a shortage of about 5,000MW of power during the summer of 2016. During the periods of such energy crises,[91] Pakistan enhanced coal fired power generation capacity by expediting projects seeking to employ local and imported coal. However, the government has reconsidered this approach since 2017 and has disallowed any new imported coal projects. Indigenous coal projects were to continue to supply only a part of the overall power demand, to ensure the socioeconomic uplift of the Thar region in particular, and to confirm the steady supply of base load power to the national grid in general.

Recent years have seen the country adopting and scaling up its green energy ambitions in the form of distributed generation and consumption, smart metering, and through the use of electric vehicles—coupled with investments into utility scale RE power plants and through increased energy conservation efforts. These measures were expected to significantly reduce energy imports, and to decrease the delivered cost of electricity, thereby offering greater self sufficiency and energy security for Pakistan.

Subsequently, the infrastructure and energy projects built under the China–Pakistan Economic Corridor (CPEC), have helped manage the energy shortfall that had plagued the country in the past.[92] The CPEC proposes to deploy about USD50 billion in investments into Pakistan based infrastructure projects including energy, roads, rail, and port projects.[93] Electricity generation capacity makes up a major proportion of the proposed investment, largely into hydropower and coal power and, to a lesser extent, into RE options.

The country's demand for energy has steadily grown in the past 50 years but since the 1980s consumption doubled every six years. In recent years, given the base effect, it has taken about 15 years for electricity demand to grow by 100 percent. During 2018 and 2019, a reduction of annual demand *growth* from previously witnessed rates of 6 percent to 10 percent, to only 2 percent was observed (owing to the base effect, among other factors).

The power plant fleet of Pakistan's energy mix is strongly dominated by thermal power. Fossil fuel driven plants account for almost 60 percent of the total installed capacity. Gas fired capacity is more than 30 percent owing to large RLNG fired combined cycle gas turbine (CCGT) plants added in recent years, followed by HFO fired and coal fired plants with 16 percent and 13 percent, respectively. At

almost 30 percent of the total capacity, hydropower plants (HPP) constitute the highest share of non-fossil fuel plants. The remaining 9 percent is split[94]among nuclear power (4 percent, but might grow with the new Karachi Nuclear Units) and all non-hydro RE plants (5 percent).

2. Principal agencies and institutions

The National Electric Power Regulatory Authority (NEPRA) was established under Section 3 of the Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997 or the NEPRA Act,1997. NEPRA provides guidelines on setting applicable tariffs, based on total costs and various financial and fiscal incentives on offer. NEPRA has also issued regulations for the smooth functioning of the sector and for promoting new forms of renewable energy. Among others, the NEPRA (Alternative and Renewable Energy) Distributed Generation and Net Metering Regulations were issued in 2015. NEPRA exclusively regulates the provision of electric power services in Pakistan and is charged with maintaining transparent and judicious economic regulation, based on sound commercial principles. It is committed to free enterprise principles and aims to provide a better quality of life for the nation's citizens.

The Water and Power Development Authority (WAPDA), an autonomous and statutory body under the administrative control of the Federal Government was established through an Act of Parliament in 1958. The authority consists of a chairman and three members, one each for water, power, and finance. WAPDA was unbundled in 2007 whereby the functions of its power wing were redefined as hydropower generation and operation & maintenance (O&M) power houses. Subsequent to the unbundling of its power wing, WAPDA was charged with the efficient development of water and hydropower resources in the country.

The Pakistan Electric Power Company (PEPCO) was established in 1998 with the express mandate of managing government owned power generation companies, the National Transmission and Despatch Company (NTDC), and distribution companies. The power sector procures fuels from a variety of domestic and imported sources and comprises a mix of state owned generation companies and privately owned independent power producers (IPP), a transmission company, and regional distribution companies.

The National Transmission and Despatch Company (NTDC) manages the nationwide transmission network and links generators with the state owned distribution companies. All these links are state owned except for Karachi's K-Electric, which also owns and maintains limited generation and transmission capacity. The distribution companies purchase power primarily from NTDC, which in turn purchases electricity from all power generators.[95] Power generation is provided by state owned generation companies (GENCOs) for thermal power, the Water and Power Development Authority (WAPDA) for hydropower, and by the independent power producers (IPPs). The exception is K-Electric, a vertically integrated, private company that provides power generation, transmission, and distribution to the Karachi metropolitan area.

- Power is purchased from generators on behalf of the distribution companies by the **Central Power Purchasing Agency (CPPA)** which acts as Pakistan's power market operator.
- **The National Power Construction Corporation (NPCC)** is a contracting and management outfit of power projects on turnkey basis—namely, extra high voltage transmission lines, distribution networks, substations, power generation plants, industrial electrification, and so on in Pakistan.

- The **Pakistan Atomic Energy Commission** (PAEC)[96] is the supplier for nuclear based energy generated by the Karachi nuclear power plant (KANUPP) and Chashma nuclear power plants I and II.

3. Legislative framework

The power sector planning has historically been part of the country's five year development plans devised by the Ministry of Finance. These plans outlined government public spending limits for economic development initiatives in various sectors with energy constituting a focal point. To overcome the challenge posed by insufficient budgets, the government attracted private sector investment by constituting the Private Power and Infrastructure Board (PPIB). This introduced the 'Policy Framework and Package of Incentives for Private Sector Power Generation Projects in Pakistan,' commonly referred to as the Power Policy 1994. This power policy was the first comprehensive policy framework for the country's power sector that allowed the development of privately owned power generation projects that could opt for any form of technology and fuel/source of energy (including wind, solar, and geothermal), select a geographic location, and make other project related decisions. It allowed the sale of electricity to Karachi Electric Supply Corporation (K-Electric) and to the Pakistan Water and Power Development Authority (WAPDA) under long term power purchase agreements (PPA).

Until August 2017, the energy sector was governed by the Ministry of Water and Power and the Ministry of Petroleum and Natural Resources until the formation of the Ministry of Energy. Consequently, existing power sector policies mainly focus on power generation and transmission, elaborating project development processes, and procedures and incentives for investors, rather than on an integrated plan for demand side management and optimal fuel mixes. The provincial governments also have their own energy departments that could and did implement power projects within their respective provinces. The main policies currently in force at federal government level under which power projects may be developed in Pakistan are briefly listed below, including the most recent electricity policy.[97]

- **Regulation of Generation, Transmission, and Distribution of Electric Power Act 1997** also known as the 'NEPRA Act 1997' clearly defines the structure, role, and responsibilities of the National Electric Power Regulatory Authority (NEPRA) thereby developing a comprehensive regulatory regime for the whole of the power sector.

- **The Policy for Development of Renewable Energy for Power Generation 2006** (also known as the Alternative and Renewable Energy Policy 2006) was Pakistan's first energy policy to promote RE power projects. The policy initially covered solar PV, wind energy, and small scale hydropower projects, while an addendum dated March 2013 led to the inclusion of sugarcane bagasse, other biomass, and waste-to-energy (WtE) projects. The Alternative Energy Development Board (AEDB) offers project initiation permits referred to as 'letters of intent' to private sector project developers of such RE projects.

- **The National Policy for Power Cogeneration by Sugar Industry 2008** was introduced in January 2008, specifically for power generation from the sugar industry using bagasse and/or coal as fuel. The incentives offered for cogeneration projects under this policy were similar to those for independent power producers (IPP) under the RE policy. Although the

cogeneration policy allowed bagasse and coal to be used as interchangeable fuels, the upfront tariff for cogeneration from sugar mills announced by NEPRA was applicable to power generated using bagasse alone.

- **The National Power Policy 2013** laid down a more effective plan to increase power generation, decrease inefficiencies, and to remove nontechnical and other financial losses while simultaneously minimizing the overall cost of power generation. The goals included building additional power generation capacity and ensuring affordable electricity for commercial, industrial, and domestic use by using indigenous resources such as coal and hydropower. The following targets were quantified:
  - Eliminating the demand/supply gap by 2017 (from 4,000MW to 5,000 MW)
  - Bringing the average power generation cost down from Pakistani Rupee (PKR) 12.00/kWh to PKR 9.99/kWh
  - Reducing transmission and distribution (T&D) losses to below 16 percent from 22 percent
  - Raising revenue collection from 87 percent to 95 percent

This policy offered a thorough analysis of the different challenges in the generation, transmission, distribution, and governance sectors while citing possible measures to overcome those challenges including the elimination of load shedding.

- **The Power Generation Policy 2015** developed under PPIB was the principal power policy for thermal and large hydropower (greater than 50MW) development, mainly for private sector and public–private partnership projects. This policy had replaced the Policy for Power Generation Projects 2002 and aimed to provide better incentives and simplified processes for power project developers. It lays down the framework for project development and underlined the importance of promoting least cost power generation. With the Alternative and Renewable Energy Policy 2006 still in force, small hydropower (less than 50MW) and other RE were not included in the 2015 policy.

- **The Policy Framework for Private Sector Transmission Line Projects 2015** provided market competitive incentives and simplified procedures to attract investors for new transmission projects. The Matiari to Lahore HVDC line (part of the China–Pakistan Corridor) was the first project under this policy.

- **The National Electricity Policy 2021** laid down a five year framework for building the foundation for the long term sustainable development of the power sector of Pakistan and aims to promote market based competition for electricity supply. The policy aims to focus on transparency, development of local fuels, and more reliance on cleaner energy. The policy envisioned special targets for RE options, long term hydro projects and the development of local fuels, paving the way for determining the power tariff through an open competitive process among private investors, thereby trying to lift the sector out of the aforementioned circular debt. The government aimed to formulate multiple subpolicies pertaining to various sectors including generation, transmission, and RE, which would eventually become part of the national electricity plan whose variables would be shifted to the Indicative Generation Capacity Expansion Plan (IGCEP) model after the requisite approvals.[98] A Clean Energy Levy on revenues of oil, gas, and coal fuel marketing companies has also been proposed as a part of the policy, which would be directed toward a Clean Energy Fund which would serve as a

source of financing for indigenous renewable energy projects. It also acknowledges that the fast track power generation has resulted in largely imported technology and O&M, and recognizes the need to indigenize the energy sector expertise.

The Grid Code[99] was developed by NTDC in 2005 to provide smooth and effective functionality of NTDC and other NEPRA licensees connected to the NTDC's bulk transmission system, and was presented and planned for the existing as well as for future connections. The grid code sets out the guidelines, rules, and procedures relating to technical and commercial relationships between NTDC and its users. Its purpose is to provide unambiguous guidelines, rules, and procedures, which ensure that all users of the grid code understand and follow the obligations and responsibilities placed upon them under the code. It covers day to day and long term principles, standards, procedures, and guidelines for planning, operation, dispatch, and connection purposes for normal and abnormal NTDC transmission system conditions. It also defines the requirements to provide ancillary services for different power plant categories—such as, black start capability, voltage ride through, and reserve provision.

At the time of its inception in 2005, the grid code mainly focused on the hydro and non-renewable power plants as there were no functioning renewable power plants in the country. As large scale grid connected solar and wind power projects emerged, the grid's capability to accommodate power from variable renewable energy sources into the power system was required to be evaluated recently. A study by the NTDC assisted by the United States Agency for International Development (USAID) was conducted to assess the technical and financial feasibility of integrating power from solar PV and wind. NEPRA has therefore amended the grid codes originally developed for thermal power projects to facilitate interconnection and power evacuation from wind and solar power plants and is expected to undergo further amendments to improve the integration of solar and wind energy to optimize the benefits of renewable power generation. The NTDC also published its second revision of the grid code for the solar PV and the concentrating solar power (CSP) plants, known as the Grid Code Addendum-II (in 2014).

4. Private investment and grievance redressal for investors

The country encourages private sector investment into the power sector and this is monitored by the Private Power and Infrastructure Board (PPIB) as mentioned in the previous section. Pakistan has established grievance redressal mechanisms for the benefit of aggrieved bidders: rule 48 of the Public Procurement Rules,[100] 2004 stated that an aggrieved bidder could lodge a written complaint within 15 days of the bid evaluation report. In order to ensure compliance with PP Rule 48, the Public Procurement Regulatory Authority (PPRA) had mandated the federal procurement agencies to provide information on their grievance redressal committees in a specified format. The lists of committees formed by procuring agencies (including NEPRA and NTDC) are published on the PPRA website (https://www.ppra.org.pk/). Aggrieved bidders can use this information to approach the procuring agency concerned.

5. RE sector development scenario and observations

The Pakistan Council of Renewable Energy Technologies (PCRET) was established in 2001 to carry out research and development, provide training, and promote RE.[101] The Federal Government of Pakistan established the Alternative Energy Development Board (AEDB) in 2003 as a statutory organization and this organization was provided a legal basis by presidential decree in 2005 and

2007. The administrative control of AEDB was transferred to the Ministry of Water and Power in 2006[102] and the Parliament of Pakistan provided legislative foundations to AEDB through the AEDB Act, in 2010.[103]

The AEDB was established with the objective of facilitating, promoting, and encouraging the development of renewable energy in Pakistan and with a mission to implement alternative and renewable energy development in the country. The Government of Pakistan has *inter alia* mandated AEDB to:

- Implement policies, programs, and projects through the private sector in the field of A/RE
- Assist and facilitate development and generation of A/RE to achieve sustainable economic growth
- Encourage transfer of technology and develop indigenous manufacturing base for A/RE technology
- Promote provision of energy services that are based on A/RE resources
- Undertake A/RE projects on commercial scale (AEDB Act 2010)

Pakistan's target was to increase variable renewable energy (VRE) to 20 percent of the electricity generation mix by 2025, and to 30 percent by 2030. To achieve such targets, a massive and immediate expansion of solar and wind capacity would be required, perhaps implemented through competitive bidding that would enhance the efficiency of project design and implementation.

In August 2020, the government formally approved the Alternative and Renewable Energy Policy 2019, which aims to boost the share of power generated from renewable sources from about 5 percent as of 2020 to 20 percent by 2025 and to 30 percent by 2030. The policy offers tax benefits to investors, encourages lower tariffs by introducing competitive bidding, and incentivises local production of RE equipment such as wind turbines and solar panels. Pakistan has a sizeable opportunity to cost effectively harness solar, wind, and hydropower potential. The shift to RE is projected to have multiple benefits for Pakistan, including reduced cost of electricity, improved energy access, and energy independence.

The expansion of RE capacity is also projected to create opportunities to establish new industries along the RE supply chain and to develop human capital through systematic capacity building and employment generation. Most significantly, the large scale deployment of RE is projected to deliver greater resilience against the impacts of climate change. In addition, such deployment is projected to result in reduced pollution and improved air and water quality. 'Net metering' legislation had been introduced for solar installations that would allow household consumers to sell surplus power to the utility grid network. This legislation is designed to encourage the adoption of rooftop solar PV installations by homeowners. Such installations could help electrify remote villages and commercial enterprises as well. Wind power projects have witnessed private sector interest owing to the sizeable investment opportunity and the relatively short project development period (especially when reliable wind resource data is available). Consequently, about 1,000MW of wind power capacity had also been developed in the recent past. Utility scale wind and solar plants are expected to be augmented by battery storage to overcome the challenge of intermittent power supply.

On the demand side, The National Electric Vehicles Policy was launched in 2020 to promote the large scale adoption of electric vehicles to try and curtail urban air pollution and to provide incentives to the local electric vehicle manufacturing industry. It is believed that the shift to electric vehicles and

to RE sources to power such vehicles could play a significant role in reducing Pakistan's oil import bill and in securing the transport sector against fuel price shocks, while also creating green business and employment opportunities.

In December 2020, Pakistan committed[104] to generating 60 percent of the country's electricity from cleaner energy sources and to 30 percent EV usage by 2030 and urged developed nations to fulfil their commitment to helping emerging economies make the transition from carbon based to low carbon energy. Given the demand patterns and the resource availability and guided by the efficiency of asset use, the present study recommends the addition of 53,840MW of solar PV capacity in Pakistan to contribute to replacing the fossil fuel capacity in the CAREC region. This focus on solar PV deployment is partly because of the relatively low PLF with which wind farm projects are reportedly operating in Pakistan and largely because of the (cost adjusted) high PLF with which solar PV projects are projected to operate. Further, to effect a complete replacement of fossil fuel sources in the region, such capacity addition would have to materialize in addition to the business as usual growth in capacity of hydropower, biomass/bagasse, and other non-fossil sources through to 2030. Given that Pakistan has the policy frameworks and the institutional structures in place, the agencies concerned would be required to coordinate efforts and to design appropriate incentives to facilitate such capacity addition in a short space of time.

6. Energy efficiency

Pakistan's RISE score of 33 was among the lowest in the region, second only to Afghanistan; it was attributed to the low electricity access and EE indicators. At 28, the RISE EE score was higher than corresponding scores for Afghanistan, Azerbaijan, Turkmenistan, Kyrgyzstan, and Mongolia.

The National Energy Efficiency and Conservation Act 2016 (NEECA Act 2016) provides the governance framework that could facilitate widescale adoption of sound EE practices throughout all sectors of economy. The act designates the National EE and Conservation Authority (NEECA) as the apex agency to coordinate and catalyze national efforts to promote conservation. While NEECA is entrusted with a wide range of regulatory responsibility, the act also recognizes the crucial role the federal and provincial bodies must play in implementation and allows them to tailor activities in a manner consistent with national and provincial priorities. With the governance framework in place, NEECA can take strategic actions in accordance with the provisions and spirit of the act.

A building energy code was prepared in the mid 1990s and is being updated. Also, after the disastrous earthquake in 2005, UNHABITAT provided support for preparing plans and designs for energy efficient housing. The code established minimum performance standards for windows; openings; heating, ventilating, and airconditioning (HVAC) equipment; and lighting. Updates of the code will be designed to ensure that the code reflects recent developments in building technology, that performance is aligned with local and regional conditions, and so on.

Pakistan submitted its climate action plan to the United Nations Framework Convention on Climate Change (UNFCCC) in November 2015. Subsequently, the Second National Communication (SNC) on climate change (May 2018) reiterates the country's commitment to UNFCCC and the Paris Agreement. While not a major emitter of greenhouse gas emissions (GHG), the country ranks among the top 10 percent of countries at risk from the impacts of global climate change.

The SNC illustrates the need for mitigation actions in the energy and agriculture sectors, as collectively they account for over 90 percent of GHG emissions. Mitigation strategies outlined in the SNC include using market mechanisms and ensuring energy pricing to consumers continues to reflect 'cost of service.' The SNC highlights the key role and active engagement of the provinces in adopting the mitigation strategies. The implementation of energy efficiency and conservation (EE&C) can leverage this successful collaboration. The SNC also recognizes energy conservation and efficiency benefits and how this remains underutilized to date. This offers the country a tremendous opportunity. Various sector studies estimate 20 percent to 25 percent energy saving potential in major sectors of the economy. This could be translated to realizable savings[105] of around USD10 billion to the national economy through to 2030.

7. Review of the framework in Pakistan

- Pakistan has an integrated legal framework in place with adequate experience with cross border trade in power with neighboring countries. The China Pakistan Economic Corridor (CPEC) could serve as a gateway for regionwide optimization and for linking the countries of the Central Asian region with the networks in China, the projected residual consumer/supplier.

- Pakistan has a matured governance framework in place and could provide requisite guidance to fellow members of the CAREC region.

H. TAJIKISTAN

1. Overview of the power sector

Given its unique geophysical characteristics, Tajikistan possesses vast reserves of hydropower resources that could be exploited during many months of the year. With a world ranking of 8 on absolute indicators of hydro resources, the country has about 4 percent cost effective global hydropower potential.[106] Annual electricity generation in the country was 16.5 billion kWh but represented the use of a mere 4 percent to 5 percent of the potential. Installed power system capacity in the country as of 2018 was 6,519MW dominated by hydropower generation plants. Tajikistan hosts reserves for coal (4.452 billion tonnes), gas (8.517 trillion m^3), and oil (117.6 million tonnes). Production of coal at 97,000 tonnes, oil at 21,000 tons, and gas at 30 million m^3, meets 16 percent of the national demand for coal, 4.7 percent of the demand for oil, and 5.4 percent of the demand for gas. Cumulative coal reserves in Tajikistan, like in many Central Asian Republics, are very extensive. However, exploiting such reserves generally requires significant initial investment to develop the requisite infrastructure. Almost all the mines in the country are located in mountainous areas, which lack the physical space for the construction of large power stations, and such locations have underdeveloped transportation networks.

The residential sector in Tajikistan accounted for about 47 percent of the electricity demand; industry accounted for about 31 percent, primarily from the aluminum production company, Tajik Aluminum Company (TALCO), while agriculture accounted for about 16 percent[107] of the total electricity demand. Aluminum and agriculture were strategically important and were significant contributors to the country's GDP and to exports.

Historically, Tajikistan's electricity tariffs have been among the lowest in the world amounting to an average of USD0.018/kWh in 2017 for domestic consumers. Reworking the tariff structure to recover the total cost of electricity generation and supply is a condition frequently attached to foreign grants made to benefit the sector, and the government has been forced to reluctantly raise end use tariffs.[108] Even though the government has gradually reformed the tariff structure, the electricity tariffs, on average, were barely above 50 percent of the levels compatible with cost recovery, and did not reflect the annual increase in debt service costs of the utilities concerned. The low tariffs, even with low marginal costs of production, have prevented plants from recovering their operating costs; creating reserves for repairs, refurbishment, and replacement of equipment; or improving infrastructural and institutional capacity at the utilities.

As of 2021, industrial tariffs stand at USD6.4/MWh in the summer and USD10.5/MWh in the winter, while residential tariffs are USD20/MWh. The government has been stepping up its actions to address the financial viability issues. Government increased the average end user electricity tariff by 22 percent and is developing a methodology for future tariff increases in order to achieve full cost recovery. In addition, some USD450 million, equivalent to about 35 percent of BarkiTojik's long term debt, has been restructured to help with liquidity issues.

Tajikistan could benefit from demand side management measures as well: the Ministry of Energy and Industry of Tajikistan had estimated that the efficiency of energy consumption could be improved by 30 percent; UNDP supported research observed that houses in rural areas of Tajikistan were poorly insulated, losing around 50 percent to 60 percent of their heat, and thereby requiring

more energy for heating. Additionally, the collection rate for billed electricity was just 85 percent, below the 95 percent threshold collection believed to be necessary for well functioning energy utilities. This was in addition to the 10 percent of electricity supplies not generating any revenue[109] for the utilities concerned.

Tajikistan was formerly connected to the other Central Asian countries as part of the Central Asian power system (CAPS) built during the Soviet era. The system was slowly abandoned in the 2000s (as Turkmenistan disconnected in 2003 in favor of trading arrangements with Iran, and in 2009 when Kazakhstan and Uzbekistan withdrew from the system) and Tajikistan was cut off owing to transit disputes and disagreements on system usage. In 2018, Tajikistan reconnected to CAPS and recommenced electricity trade with Uzbekistan.[110]

2. Principal agencies and institutions

The policy making bodies of the country are the MazhilisOli of the Republic of Tajikistan (Parliament), the President, and the Government along with the following ministries:

The mandate of the **Ministry of Energy and Water Resources** is to harmonise energy and water policy through planning the development of energy and water resources, capacity building, management and regulation, and exercising state control over the rational use and protection of water resources. It also facilitates investment and concession agreements in the energy sector, and is responsible for coordinating activities of the ministries and the concerned agencies involved in water resources. The Ministry is the authority and leading body (nationally) on policy related to the integrated use of water resources.

The Ministry of Economic Development and Trade is responsible for developing various strategies for socioeconomic development along with state programs for internal and external investments. It manages the **Antimonopoly Committee** which regulates the tariffs of the main power utility company BarkiTojik(BT). It is also responsible for both sector specific and regional development programs, developing principles and mechanisms for economic reform.

The Ministry of Finance is responsible for proposing and allocating budgets for state owned companies. The MoF handles debts and finances from multilateral institutions. The Agency on Statistics (TajStat) is the central statistical office involved with collecting and disseminating key data on demographics, and other figures of national importance.

The Open Joint Stock Holding Company (OHSC) **BarkiTojik (BT**) is the state owned integrated electric utility service provider responsible for generation, transmission, distribution, and retail sales. It was unbundled into three separate companies, with ongoing separation of responsibilities. The utility's supervisory board comprises ministers and is chaired by the Prime Minister. BarkiTojik's efforts in expanding the supply eliminated the regular electricity shortage in the country during the winter of 2017. BT is responsible for supplying most of Tajikistan's electricity needs, except for the Gorno-Badakhshan Autonomous Region (GBAO) autonomous region, which is supplied by Pamir Energy (formed in 2002 to meet the energy needs of the residents of the GBAO region, a mountainous territory bordering the People's Republic of China).

In 2016, Tajikistan launched the National Development Strategy 2030 which includes a goal to become energy independent. The strategy's primary aims included:

- Increasing installed capacity by 10GW[111]
- Reducing technical grid losses by 10 percent
- Increasing electricity exports to 10TWh per year
- Diversifying generation sources by increasing non-hydro generation capacity to at least 10 percent of the total share
- Achieving energy-savings of 500GWh from EE measures

The energy prices and electricity tariffs are set by the Antimonopoly Committee of the Ministry of Economic Development and Trade on an ad hoc basis. In the past, tariffs had not been reflective of the cost of service. However, in 2017, a new tariff methodology was established. It aimed to increase electricity tariffs gradually (by 2025) to achieve cost recovery, thereby establishing a required income for the generation, transmission, and distribution assets.

3. Legislative framework

The development of energy sector in the Republic of Tajikistan (RT) is guided by the following laws.

Constitution of the Republic, The Law 'On Energy,' The Law 'On Energy Conservation,' other acts and international norms recognized by the Republic. These acts are determined by prevailing government policy and prescribe regulatory measures in energy use and energy saving. The regulatory mechanisms also define the administrative procedures for energy companies and property rights in the energy sector, including the protection of consumer rights. They point to the necessity of having a specialized state agency for energy control, to determine energy efficiency standards, to undertake certification and metrology procedures, and to define and impose liabilities for breach of energy legislation.

The process of regulating the electricity sector in the country is divided, both in law and in practice, among various agencies. These agencies are the Government (policy making), Parliament (debate and approval), Ministry of Energy and Industry (implementation), and Ministry of Economic Development and Trade (financial aspects and international relations relating to energy).

The legal framework in Tajikistan does not include laws specifically intended for regulating the electricity sector. However, the law that regulates the electricity sector, the Law of RT 'On Energy' lays out the legal authority empowering the regulatory bodies without clearly defining jurisdiction. The Ministry specific acts are also generic in nature; they do not clearly define the way the said ministries relate to the electricity sector because activities within this sector are not considered to be standalone. The Law of the Republic 'On Natural Monopolies' indirectly relates the Ministry of Economic Development and Trade to be the regulatory body to a limited extent, but it does not clearly define the way the Ministry can regulate the electricity sector. It is difficult to define the full range of functions to be entrusted to the regulatory body and the jurisdiction of regulatory relations is ambiguous in the present setup.

4. Private investment and grievance redressal for investors

Tajikistan's legal system does not discriminate against foreign investors by prohibiting, limiting, or conditioning foreign investment. Tajikistan has several formal mechanisms to maintain open channels of communication with existing as well as potential investors. With support from EBRD, the Government established a consultative council on the improvement of the investment climate in 2007. However, to receive permission and licenses for operation, a foreign investor must navigate a complicated, cumbersome, and often corrupt bureaucratic system. The Pamir Energy Company was the first public–private partnership in the power sector.

A number of laws regulate private investments, such as the Production Sharing Agreements (2008), Credit Histories (2009), Concessions (2011), Public–Private Partnerships (2012), Investment Agreements (2016), and Privatisation of State Property (1997, updated 2017). Other related laws include the Law on Legal Status of Foreigners, Law on Resources, Law on Investments, Law on Free Economic Zones, Concept of State Policy on Investments and Protection of Investments, and Law on Natural Resources Tenders.[112] A few mechanisms under these laws include:[113]

- Income tax exemptions based on amount invested
- Tax and customs benefits for relevant equipment and machinery for energy production
- Legal status for the investor, with many provisions such as the right to transfer profits abroad
- Capital protection, with legal frameworks, partnership and investment agreements

The privatization of most of the small, medium size, and many large state owned enterprises is ongoing, although this has been affected by corruption and insider deals. There are legal guarantees for the freedom to invest or withdraw from the market, but they are deterred by the regulatory authorities from rampant corruption and extortion. The presence of the large number of state owned companies prevents fair market competition, although the state owned enterprises have more favorable access to finance from state owned banks.[114]

Tajikistan has signed and ratified the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards (1958), although with a number of reservations regarding types of arbitration agreement and decision that Tajikistan can recognize and implement. Tajikistan acceded to the Convention on 14 August 2012, but it was enforced on 12 November 2012—90 days after depositing the signed text at the UN and in accordance with Article XII (2) of the Convention. However, it also needs to be noted that Tajikistan is not a member state at the International Center for Settlement of Investment Disputes.

5. RE development scenario and observations

Tajikistan's **Law on Renewable Energy Resources, 2010 (Law No. 587)** regulates the renewable energy sector and the relationships between state bodies, natural and legal persons operating in this sector in Tajikistan. The law provides definitions on terms like 'renewable energy' and how it is defined from a legal perspective in the country and stipulates how it can be efficiently incorporated to the energy system of Tajikistan. The law permits renewable energy developers to renew and enhance their existing equipment and technologies for the purpose of the renewable energy projects in accordance with the applicable laws and regulations. The Law on Use of Renewable Energy Sources is a legal basis for the creation and adoption of by-laws which further regulate the renewable energy sector in greater detail. The law calls for the creation of guaranteed purchase prices for electricity

generated from renewable energy projects. Tariffs are to be determined in accordance with the generation costs of each project.[115]

The above law regulates activities in the field of renewable energy resources in the Republic of Tajikistan, and includes:

- Establishment of the principles and purposes of state policy in the field of development of renewable energy resources
- Determination of methods of integration of renewable energy resources in a republican power system
- Performance of organizational, research project, expert, design, regulating activities, uses of renewable energy resources directed to increase
- Provision of correlation (interrelation) of activities in the field of production, accounting, transportation, distribution, and energy use from renewable energy resources
- Determination of the economic and organizational measures directed to production incentive and uses of renewable energy resources

The law also stipulates that a priority for renewable energy projects is to be given to very remote areas with low population densities (around 10 percent of the population) where grid reinforcements or new connections are not considered feasible and to areas suffering from power supply shortages. Tajikistan has a favorable climate for harnessing solar energy. Exploration of its potential may satisfy around 10 percent to 20 percent of energy demand in Tajikistan. The high costs (2.5 cents/kWh for solar and about 20 cents/kWh for wind power) discourage industrial scale public or private solar energy. Despite the costs, in 2020, the country's first solar power plant (220kW capacity) was launched in Murghab (GBAO) with the cooperation of the US Agency for International Development (USAID) and Pamir Energy.

The penetration of solar energy technologies, as of 2020, was limited to several off-grid installations across the country. Further, the tariff on offer for electricity from solar photovoltaic plants is observed to be insufficient to cover O&M costs and might not ensure sustainability of investments. Similarly, the generation of electricity in small remote villages using small wind turbines is also not practical because of an even higher generation cost of electricity and the need for periodic maintenance by relatively highly skilled technical personnel.

6. Energy efficiency

In 2013, Tajikistan had adopted the standard on 'Energy Saving. Informing Consumers about Energy Efficiency of Household and Municipal Products' (ST RT GOST R 51388-2010). This standard specifies the ways and means of informing consumers about the energy efficiency of household appliances, thermal insulation products and materials, municipal heat and power equipment, and individual motor vehicles. It also defines the general requirements, rules, and the amount of information on energy efficiency to be communicated to consumers, energy efficiency classes, and indexes of operational energy efficiency.

The Ministry of Energy and Water Resources (MoEWR) of the Republic of Tajikistan is the country's regulator in the energy and EE sector. The ministry is responsible for:

- Developing the regulatory, legal, and organizational structures
- Developing and approving regulations on energy diagnostics and building expertise in EE and ES
- Defining energy efficiency specification for buildings, constructions, and structures
- Developing and coordinating sectorwise energy saving and EE programs

The National Development Strategy (NDS) for the period up to 2030 (2016) considers EE by including the 'efficient use of electricity' and 'energy saving' as part of the overall development goal. It also outlines the urgent need for implementing EE and conservation measures in all sectors of the national economy. Although it is a high level policy framework, the NDS sets the target to achieve 500GWh of electricity saving by 2030.

Electricity prices in Tajikistan are extremely low because the government fixes the tariff at such levels, they do not provide a motivation for enhancing energy efficiency. EE activities of the utility are focused on reducing losses in the transmission and distribution grid. Utility led demand side management (DSM) programs are yet to be designed and implemented.

With a RISE score of 59, Tajikistan appears close to the global average of 61. The country received an energy efficiency score of 47. The foundation of Tajikistan's regulatory framework for EE and energy conservation is the Law 'On Energy Savings and Energy Efficiency' from September 2013. The law stipulates the legal and organizational framework for EE and provides for the introduction of EE materials, appliances, and technologies. The law has provisions for introducing mandatory energy audits, establishing procurement procedures that incorporate criteria on energy efficiency, requirements for energy use in buildings and household appliances, and so on. The law also stipulates setting standards and certification for EE equipment, materials, buildings, vehicles, and other energy consuming products.

The Tajikistan Power Development Plan[116] considers electricity savings from the following six different EE measures:

- Tajik Aluminum Company (TALCO) industry
- Public awareness
- EE standards and labeling
- Water pumping
- Solar hot water heating
- CHP heating

Recently, the Tajikistan government has developed a new 'Energy Saving and Energy Efficiency Program for 2021-2025' (draft) that envisages a step-by-step approach to EE and ES implementation. At the initial stage the program will focus on:

- Low cost measures considering peculiarities of energy consumption in Tajikistan
- Creating an institutional environment for ES and EE
- Providing information
- Measures in the public sector

For the EE measures to yield tangible results there might be merit in reviewing the tariff structures to ensure total cost recovery for the utilities, while simultaneously providing transfers for the vulnerable sections of society to help them cope with the higher costs of everyday life flowing from such tariff revision.

7. Review of the framework in Tajikistan

- A well structured public–private partnership law and tendering infrastructure projects in a transparent manner with regular and structured audits would help encourage private sector participation.

- Proper and unambiguous division of authority and responsibility with fully defined scope are required for various regulatory bodies to avoid conflicts of authority.

- A strong central and municipal government leadership and a long term vision around increasing private sector participation in infrastructure are key as it will attract private investment into sectors including energy.

I. TURKMENISTAN

1. Overview of the power sector

Turkmenistan is an upper middle income country and the second highest per capita GDP in Central Asia. While Turkmenistan's share in global GHG emissions is small, its economy is one of the most energy intensive owing to natural gas leaks in the oil and gas exploration sector and the very high energy subsidies that had until recently made energy practically free for the local population.

Turkmenistan's government has been continuously investing in the oil and gas sector, to modernize and expand the electricity supply and heat provision in the country. Turkmenistan's electricity generation routinely exceeded domestic consumption, allowing the country to export the surplus production. The country is linked to the Central Asian electricity grid and exports electricity to Afghanistan, Iran, and Turkey among other Central Asian countries. Turkmenistan had planned to increase power generation from 19 billion kWh in 2011 through 27 billion kWh in 2020 and eventually to 35.5 billion kWh by 2030 to meet domestic demand as well as for exports. Following such programs, the country's total installed generation capacity stood at nearly 5,200MW as of April 2018. In 2013, the government developed a policy of modernizing and expanding its electricity sector by increasing transmission infrastructure and constructing 14 natural gas fired electric power plants to be commissioned between 2013 and 2020. As of April 2016, Turkmenistan had 12 thermal power plants in operation.

On the demand side, the energy sector is almost fully subsidized, with citizens receiving free electricity, up to a specified level of consumption,[117] until 2030. The government is taking measures to reduce subsidies to curtail domestic demand and to increase exports. Turkmenistan is also part of the EU4Energy Program, an initiative focused on evidence based policy making for the energy sector.[118]

Turkmenistan has the world's fourth largest natural gas reserves, estimated at about 19.5 trillion m^3 (tcm) located mainly in the southeastern part of the country, which could allow the country to ship growing volumes of gas profitably, to international markets, obtaining lucrative export revenues to boost the national budget.

However, Turkmenistan has been not able to develop alternative and concrete corridors to diversify its hydrocarbon exports. As of 2021, the development of new export routes has become one of the key priorities in the country's energy strategy, exploring possibilities of boosting the national energy budget with the additional fuel export revenues. Following the halting of exports to Iran and Russia, the country could benefit from revenues derived from export to China as most of such revenues are used to repay loans owed to China. Consequently, the national budget has been deprived of economic resources, which could be committed to finance social programs and public policies, pushing the Turkmen authorities to introduce payments for utilities (natural gas, water, electricity) which were hitherto supplied free of charge.

The TAPI gas pipeline project—linking Turkmenistan, Afghanistan, Pakistan, and India—is conceived as an alternative eastern corridor for gas exports—preferred to exports to China—which pipeline is designed to supply South Asian markets with 33 bcm/y of gas[119] from Turkmenistan.

2. Principal agencies and institutions

The electricity sector in Turkmenistan is supervised by the **Ministry of Energy and Industry** and generation is fueled almost entirely by natural gas. **The Ministry of Finance** is responsible for handling tariff methodology matters and setting basic tariffs for transmission. The Ministry of Finance includes **Turkmenenergo State Electric Energy Corporation,** which is a vertically integrated entity responsible for managing all state assets in the sector.

To manage the country's oil and gas sector, a new governmental authority—the **State Agency for the Management and Use of Hydrocarbon Resources** under the President of Turkmenistan—was established in March 2007 by a presidential resolution. The agency was accountable for matters relating to hydrocarbon resources and their utility. It included those relevant to political decisions on gas export, construction of new export gas pipelines, and others. There are no independent regulatory authorities in Turkmenistan.

3. Legislative framework

The main law that governs and regulates the power sector is the **Law on Electric Power Industry (2014).**[120] It mandates the following under Article 11 Competence of the Authorized Body (Ministry of Energy of Turkmenistan) in the Electric Power Industry.

The authorized body in the field of electric power industry:

1) Realizes:
- The state policy in the field of electric power industry
- The main principles and priority directions of economic reforms in the electric power industry
- State programs for the development of the electric power industry

2) Develops and submits to the Cabinet of Ministers of Turkmenistan:
- Draft state programs for the development of the electric power industry
- Draft regulations for the use of electrical and thermal energy
- Draft rules for the protection of electrical networks
- Offers on tariffs for electricity (heat) supplied to consumers in Turkmenistan
- The draft of the procedure for the development and implementation of measures to ensure the sustainable operation of enterprises in the electric power system in emergency situations
- The project of the procedure for compensating losses of power supply companies associated with free electricity, as well as preferential supply of electricity to the population and other consumers in accordance with the legislation of Turkmenistan

3) Approves:
- Rules for the installation of electrical installations
- Rules of technical operation of electric power facilities
- Safety regulations for the operation of power facilities
- Regulations on economic relations between the subjects of the electric power industry
- Regulations on the organization of electric power supervision
- The procedure for the full or partial restriction of the consumption of electricity in the event of a violation of its obligations by consumers, as well as in urgent measures to prevent or eliminate accidents
- The order of centralized operational dispatch control of the electric power system of Turkmenistan

- Normative documents in the electric power industry

4) Ensures safe and reliable operation of the electric power system, carries out electric power supervision

5) Participates in the formation of the balance of production and consumption of electric energy

6) Establishes the mode of operation of the electric power system

7) Manages the electric power system of Turkmenistan

8) Participates in the development of:

- Rules for ensuring industrial, fire, and environmental safety in the design, construction, operation, decommissioning of power system facilities
- Draft normative legal acts regulating relations in the field of electric power industry
- Draft state standards for the quality of electrical (thermal) energy

9) Develops and implements measures for the rational use of electricity and fuel and energy resources, along with the use of renewable energy sources

10) Carries out:

- Measures for reconstruction, modernization, development of generating capacities and electric networks
- Licensing of activities in the electric power industry
- Technical and technological supervision and control in the electric power industry
- Within its competence, consideration of cases of administrative violations in the field of the electric power industry in accordance with the legislation of Turkmenistan
- International cooperation in the field of electricity
- Other authorities in accordance with the legislation of Turkmenistan

4. Private investment and grievance redressal for private investors

Although Turkmenistan is open towards foreign investment, its foreign investment climate has been defined by the tight state control of the economy, lack of transparency, the government's inability to meet its financial obligations, and a highly restrictive visa regime. Under the applicable law, all local and foreign entities operating in Turkmenistan are required to register their organizations with the registration department under the Ministry of Finance and Economy. However, an interministerial commission including the Ministry of Foreign Affairs, the Agency for Protection from Economic Risks, the law enforcement agencies concerned, and industry specific ministries are required to provide approval before such registration.

The government barely allows foreign ownership and foreign direct investment in the energy sector even though there are no legal restrictions. The legal system permits foreigners to establish and own businesses and to engage in business activities. However, revenue repatriation is challenging because of the difficulty in currency conversion. Moreover, the government discriminates against investors in several ways, including arbitrary license extension denials, excessive and arbitrary tax examinations, and customs clearance and visa issuance obstacles. The government insists on maintaining a majority interest in any joint venture (JV), which acts as a deterrent to attracting foreign investment.

Foreign investment in the country is regulated by the Law on Investments (amended in 1993), the Law on Joint Stock Societies (1999)—which relates to startup corporations, mergers, acquisitions, and takeovers—and the Law on Foreign Investment (amended in 2008). Foreign investment activities are affected by several bilateral or multilateral investment treaties, along with the Law on Enterprises (2000), the Land Code (2004), and the Law on Business Activities (amended in 2008). Foreign investment in the energy sector is subject to the 2008 Petroleum Law, also known as the Law on Hydrocarbon Resources

(amended in 2011 and 2012). This law contains the legal framework which was a partial step toward creating a more transparent policy in the energy sector.

Turkmenistan was a party to the 1995 Convention on the Settlement of Investment Disputes between States and Nationals of Other States (ICSID). The commercial law enforcement system includes the Arbitration Court of Turkmenistan, which tries 13 categories of both precontractual and postcontractual disputes, including taxation, legal foundations, and bankruptcy issues. The court only reviews disputes upon the request of parties involved and does not interfere in an enterprise's economic relationships. Appeals to decisions of the Arbitration Court can be filed at the Arbitration Committee of the Supreme Court of Turkmenistan. Although Turkmenistan has adopted a number of laws designed to regulate foreign investment, implementation of these laws has been weak. Further, the government does not always distinguish between foreign investment and loans from foreign financial institutions.[121]

5. RE development scenario and observations

Turkmenistan has a huge potential for wind and solar PV derived energy, but rich gas and oil deposits have discouraged development of the RE sector. Besides, the population does not pay for electricity consumption because of the state sponsored subsidies. This has caused RE projects to be viewed as being uncompetitive and unviable.

The National Climate Change Strategy for Turkmenistan highlights the modernization of gas and oil pipelines as a priority, especially for reducing leakage. For RE, the CC strategy calls for small and medium sized RE projects in remote and sparsely populated regions 'in the short term' which the strategy defines as by 2020. In the medium term (which the strategy defines as the period between 2020 and 2030) and in the long term (presumably beyond 2030) the strategy aims to have larger scale generation and increase the share of RE in electricity generation. However, the quantum of RE generation in the mix is not defined.

As of the end of 2020, the country did not report operating hydro or non-hydro RE projects in the energy mix. Turkmenistan aims to set up a solar institute to pave the way for detailed investigations into the potential of RE sources in the country, improving scientific and technological research and introducing relevant scientific studies and innovations.[122]

6. Energy efficiency

The harsh climatic conditions in Turkmenistan make heating and cooling in buildings essential to the wellbeing of a country of 5.94 million people. The temperature range varies from an average -6 degrees Celsius in the northeast of Turkmenistan in January to a maximum 48 degrees Celsius to 60 degrees Celsius in the central and southeastern Karakums in the summer. For this reason, cooling in the housing stock in summer is as important as heating in the winter.

The Government of Turkmenistan has established a national EE framework with a strong focus on the residential sector. Saving targets for large industrial and commercial energy consumers are also in place. However, the Government has not laid down minimum EE performance standards or the mandate for information providing labels for household appliances and other equipment. The low electricity tariff does not motivate investments into EE. Consequently, Turkmenistan's overall RISE score was 41, while the regulatory framework on EE was awarded a score of 25.

Turkmenistan has approved two strategic documents related to EE: the National Strategy on Climate Change (15 June 2012) and the EE Program for 2018-2024 (21 February 2018). According to these documents, EE and energy saving, rational use of natural gas and oil products, and increasing the use of alternative energy sources are the main priorities of policies to limit greenhouse gas emissions.

The main national policy instruments for the implementation of measures are:

- Improvement of the regulatory and legislative framework
- Improvement of institutional structures
- Introduction of financial instruments stimulating the reduction of greenhouse gas emissions
- Creation of a national greenhouse gas monitoring system, and development of information tools

As of 1 January 2019, gas, electricity, water, and other social benefits for the population of Turkmenistan are reported to have been abolished. This decision was explained by the increased income of the population and the need to reorient the benefits in favor of future generations.[123]

Specific measures to improve the EE of industries and individual productions will be developed considering their specifics and technological processes. General approaches for the successful development and implementation of EE measures are common:

- Development of energy saving programs for individual industries
- Improvement of the system of commercial and technical accounting of energy resources consumption at enterprises
- Modernization of existing technological processes as well as optimization of the structure of specific enterprises
- Introduction of energy management, analysis of the main technological processes
- Special training of personnel, increasing their interest in energy saving

Priorities for the development of the housing and community sector considering EE improvements are:

- Improving the efficiency of urban heating systems
- Further renovation of the housing stock, considering climatic changes
- Improving the normative base of construction standards and regulations to ensure EE and thermal reliability of buildings
- Working to raise awareness and interest of the population
- Certification of household appliances for EE

However, it should be noted that these strategic documents are more in the character of vision statements, as they do not specify the roles and responsibilities of a specific state body in implementing the tasks, and the documents do not specify quantitative—or at least verifiable—indicators with respect to which their implementation can be measured.

The Ministry of Construction and Architecture of Turkmenistan is the state body responsible for EE of the buildings. The Ministry's structural subdivision—State Design Scientific Production Association 'Turkmendovlettaslama'—and the National Committee for Hydrometeorology under the Cabinet of Ministers carry out work on improving EE in buildings.

In recent years, specialists have revised such construction norms as 'roofs,' 'residential buildings,' 'construction climatology,' and 'construction heating technology.' The government's quantitative target is to reduce the energy use in residential buildings. The first EE priority assumes the reduction of electricity consumption in the residential sector by 20 percent until 2030 and 40 percent by 2040 compared to the reference case. Efficiency of energy use in building must be improved through

retrofitting the building envelope and heating systems, and the further improvements of energy performance through the implementation of the building code for new buildings. The target for energy efficiency in industries is increased to achieve savings of 10 percent in 2030 and 20 percent in 2040. This could be achieved if the government worked towards defining mandatory standards on energy management and auditing for industry.

7. Review of the framework in Turkmenistan

- The expansion of the electricity grid network in Turkmenistan could follow in the footsteps of the negotiations held in the context of gas export networks.
- The country could use gas as a bridge until all the projected non-fossil fuel generation capacity and the network links are commissioned.

J. UZBEKISTAN

1. Overview of the energy sector

Uzbekistan is endowed with adequate energy resources to meet the country's energy needs and to cater to exports to neighboring countries. Achieving energy security was considered one of the prerequisites for achieving economic stability in the country. The power generation capacity in the country in 2018 was close to 14,000MW and Uzbekistan had proposed to increase capacity[124] to 78,000MW by 2030 to meet domestic demand and export demand in neighboring countries. In view of this heightened priority, the government restructured the energy sector in 2019 and had been working towards liberalization of the sector to improve competitiveness. Apart from structural changes, the government had also made changes to the regulatory framework by enacting laws relating to public–private partnerships, renewable energy, and related subjects.

According to the World Bank database, 100 percent of Uzbekistan's population had access to electricity[125]by 2019. However, the power supply is often unreliable, with frequent interruptions. Losses in the transmission and distribution system averaged 17.4 percent of the input energy in 2019; to put this in perspective, this magnitude of loss was three times that in the Organization for Economic Cooperation and Development (OECD) countries.[126]

As indicated in **Table 2.10,** the installed power generation capacity in 2020 stood at 16,041MW, 87 percent of which was based on non-renewable fuel sources and a mere 13 percent on RE sources. Of the 2,009MW installed RE capacity, 2,005MW was hydropower, approximately 4.0MW was solar energy, and approximately 1.0MW was wind energy generation capacity.

Uzbekistan has had a long history of regional cooperation with Kazakhstan, Kyrgyzstan, and Tajikistan; and has interconnected networks for power trade. The countries operated under the framework referred to as the *United Dispatch Administration of Central Asia* and later the *Central Asia United Power System Council*. These countries have created a *Coordinating Power Council of Central Asia* within which a regional coordination center—the Coordinating Dispatch Centre (CDC) Energia—operates to manage demand and supply across parts of the region.

Annual peak load in Uzbekistan is around 9,500MW, while the difference between peak and off-peak load in Uzbekistan for one day is about 3,000MW. To meet the country's peak load in summer, Uzbekistan imports power from Kyrgyzstan. During lean hours Uzbekistan's power plants can meet the domestic demand. Uzbekistan has engaged in cross border power exchange with Tajikistan and Turkmenistan prior to 2015. However, since 2015, the country has largely exported electricity to Afghanistan, and both exported and imported power to Kyrgyzstan as indicated in **Table 2.11**.

2. Principal agencies and institutions

In its present form the **Ministry of Energy** of the Republic of Uzbekistan was established by presidential decree of 1 February 2019 titled 'On measures to radically improve the Management System of the Fuel and Energy Industry of the Republic of Uzbekistan.' The Ministry of Energy regulates the generation, transmission, distribution, and consumption of heat and electrical energy.
The main objectives of the ministry include:

- Regulation of the energy sector

- Implementation of production sharing agreements and supervision of their execution
- Development of public–private partnership arrangements
- Improvement of the tariff policy to facilitate the formation of a competitive business environment, increasing and diversifying energy production (tariffs are set by the Ministry of Finance)
- Implementation of a modern corporate governance in the energy sector, based on inputs from the World Bank

The decree also restructured Uzbekistan's generation and distribution entity ***Uzbekenergo* JSC**. In addition, three joint stock companies—Thermal Power Plants JSC, Main Electric Networks of Uzbekistan JSC, and Regional Electric Networks JSC—were constituted to take its place. These entities are collectively responsible for the design, construction, installation, and commissioning works in the country. They are also responsible for the repair and maintenance of the main equipment and accessories of power plants and grid networks.[127]

Although the country is working towards increasing the share of renewable energy (RE) in its electricity production mix, no specialized agency had been constituted to oversee the implementation of RE projects. The Ministry of Energy continued to be responsible for all activities related to renewable energy including:

- Implementing a unified state policy in the use of renewable energy sources
- Coordinating the activities of the state and economic management bodies
- Developing and approving, within the limits of its authority, technical regulations, norms, and rules
- Maintaining state records of resources of renewable energy sources, energy produced from renewable energy sources, and installations of renewable energy sources
- Organizing advanced training, retraining and training of personnel in the field in the field of the use of renewable energy sources; and many others.[128]

The Ministry of Finance is in charge of setting tariffs in the power industry. Several other agencies work within the power sector: **Uzenergoinspektsiya** monitors compliance with relevant state standards in the energy, and **Uzatom** is the agency responsible for the development of nuclear energy, and is the non-commercial organization for implementation of production share agreements. In addition to these agencies, the **Uzbek Agency for Standardization, Metrology, and Certification** monitors compliance with power, energy efficiency, and energy quality standards. Uzbekistan has also instituted a State Antimonopoly Committee which ensures natural monopolies adhere to market rules and regulations, including the rules for price setting.[129]

Ministries indirectly involved in the electricity sector are the **Ministry of Investment and Foreign Trade**, which is responsible for coordinating efforts to attract foreign investments and for implementing the unified state investment policy. The **Ministry of Construction** is involved in urban planning and is responsible for introducing innovative energy efficient and energy saving projects and solutions into construction.[130]

Thermal Power Plants JSC is responsible for electricity generation, while National Electric Networks of Uzbekistan JSC is responsible for electricity distribution through a total cable length of more than 9,700 km and main electric grids with a voltage of 220kV and 500kV. The Regional Electric Grids JSC is responsible for supply of electric energy to consumers nationwide through electricity grids of 14 territorial distribution and sales enterprises. The country is home to a total length of more than

250,000 km of power transmission lines with 1,700 substations and transmission voltage of up to 110kV.

The Ministry of Finance sets the tariffs based on the *Regulations on Tariff Groups of Consumers of Electrical and Heat Energy*, which defines three types of tariff and ten groups of consumers. The three types of the tariff are:

- Single rate tariffs: usually the fee per 1kWh of active power energy supplied to customers
- Double rate tariffs: the annual payment for 1kW of the maximum power capacity declared for consumption by customers and the fee for 1kWh of electricity that is actually supplied
- Differential (time of use) tariffs: local distributors have the right to differentiate energy tariffs based on time periods of the day (peak hours, half peak hours, or night load) and seasons (summer and winter periods), provided that customers have multitariff metering devices

The Government provides certain discounts to socially vulnerable consumers, based on relevant presidential decrees. Tariffs set by the Ministry have remained significantly below the levels that would be consistent with full cost recovery for the utilities concerned and, as a result, revenues have not met ever growing demands for investment into refurbishment and upgrades.[131] The tariff rates defined by the Ministry are as indicated in **Table 2.12.**

Another important project that the Ministry is implementing at an accelerated phase is the introduction of an *Automated System for Metering and Control of Electricity* (ASMCE). The country planned to connect more than 7 million consumers to the automated system for monitoring and metering of electricity by the end of 2020. By mid 2019, 956,180 units of modern electric meters were installed nationwide.[132]

3. Legislative framework

The major laws governing power sector in Uzbekistan are listed within this section:

The Law on the Rational Use of Energy: This law was originally drafted in April 1997. However, in 2020, the Republic of Uzbekistan adopted a new version of the law. The law stipulates that the Ministry of Energy is authorized to implement a unified state policy on *rational energy use*, applicable to all social facilities and economic sectors.[133] This Law establishes general legal frameworks for the conservation of energy resources and the sustainable use of energy in the Republic of Uzbekistan. The framework covers activities related to extraction, production, storage, supply, distribution, and consumption of energy. It also covers finer aspects such as efficiency, standardization, and environmental impact related to the power sector.[134]

Law No. ZRU-225 on Electric Power Industry: This law was adopted by the Legislative Chamber in 2009, and its purpose is to regulate relations in the field of the electric power industry. It determines the tasks, functions, and responsibilities of national institutions and other actors involved at national and subnational levels in energy supply, distribution, and operational control. Also covered under this law are the rights and obligations of the electricity consumers, metering, and conditions for suspension of supply.[135]

Law No. ZRU-565 on Peaceful Uses of Nuclear Energy: Adopted in 2019, the law defines the regulation in the field of use of atomic energy for peace purposes. The law prohibits the use of nuclear energy for nuclear weapons and other nuclear destructive devices; and defines the activities

for which nuclear energy could be used.[136] Owing to lack of regulatory specifications in the field of atomic energy the Government decided to apply the standards and norms of the Russian Federation in this field. *Uzatom* was established as prescribed by this law to regulate all matters related to nuclear energy. The Department of Nuclear Safety was established to supervise areas of industrial radiation and nuclear safety.[137]

Law No. ZRU-539 on the Use of Renewable Energy Sources (RES): Adopted in 2019, this law specifies preferences for RE technology use, including incentive structures to promote RE in the country:[138]

- Manufacturers of RE equipment are exempt from paying all types of tax for five years from the date of the company's registration
- Property tax for renewable energy installations and land tax for the areas occupied by these installations (rated capacity of at least 100kW) are exempt for ten years from the date of commissioning
- Subject to complete disconnection from existing energy networks, land tax is exempted for consumers using RE at their residence for three years from the month of first RE use

Environment related laws: The Regulation 'On State Environmental Expertise' (2018); and the Law of the Republic of Uzbekistan 'On Environmental Expertise' (2000), Resolution of the Cabinet of Ministers 'On further improvement of the EIA mechanism' (2020): An EIA is to be undertaken prior to project implementation. The EIA report forms part of the project documentation, for existing enterprises and other facilities subject to expansion, reconstruction, technical refurbishment, or changes in the technological process that could potentially negatively affect the environment and health of citizens, and for facilities with a special legal regime for activities related to categories I and II of environmental impact (high and medium risk). Projects with a total capacity of 500MW are categorised as category I.

Other laws indirectly related to the energy sector are:

- Law No. 312-II on Production Sharing Agreements—introduced in 2001, this law regulates the relation among agencies arising in the course of the conclusion, execution, and termination of production sharing agreements when implementing investments into searches, investigation of fields and mining in the territory of the Republic of Uzbekistan[139]

- Law No. ZRU-370 on Joint Stock Companies and Protection of Shareholders' Rights—introduced in 2014, this law deals with the formation and legal status of joint stock companies.[140] Foreign investors looking to invest in the country's energy sector through formation of joint stock companies would have to study this law

- Law No. ZRU-537 on Public–Private Partnerships—introduced in 2019, the purpose of this law is to regulate relations in the field of public–private partnerships[141]

4. Private investment and grievance redressal for investors

Uzbekistan has been working with the International Finance Corporation (IFC) to open up the country's power sector to private investments and attract foreign capital in an efficient and transparent manner.

- In early 2021, the Ministry of Energy of Uzbekistan invited public–private partnership (PPP) tenders for two photovoltaic solar plants (solar PV) in the Samarkand and Jizzakh region. The PPP projects were expected to add 400MW of RE to Uzbekistan's energy mix. The tender attracted six bids in the Samarkand region and seven bids in the Jizzakh region. *Abu Dhabi Future Energy Company* PJSC, also known as *Masdar*, won the bids in both regions, with a bid to supply solar power at 1.791 US cents/kWh in the Samarkand region and 1.823 US cents/kWh in the Jizzakh region. In all, Uzbekistan intends to add 8.0GW of solar PV and wind energy capacity by 2030, generating 270GWh of electricity, and thereby reducing annual greenhouse gas (GHG) emissions by 160,000 tonnes of CO_2 equivalent,[142] relative to the business as usual growth projection and energy mix. The present study recommends the addition of some 19,400MWp of solar PV capacity in addition to the projected growth in HPP and RE capacity to contribute to displacing the fossil fuel based generation in the region.

- In May 2021, Saudi Arabian energy company ACWA Power executed an implementation agreement with Uzbekistan's Ministry of Investments and Foreign Trade, and the Ministry of Energy to develop, build, and operate 1,500MW of wind energy capacity in Karakalpakstan.[143]

- In September 2021, under the 'Uzbekistan wind program,' the Ministry of Energy called for a bids for a 100MW wind based power generation project in the Qorao'zak District of Karakalpakstan region. Three bidders had submitted their tenders by the deadline and the winners are yet to be announced. The Government of Japan and the European Bank for Reconstruction and Development (EBRD) provided technical support for the project.[144]

In early 2020, a new Law on Investments and Investment Activities came into effect to combine the legal acts regulating the investment activities into a single document.[145] This law effectively replaces the Law on Investment Activities, the Law on Foreign Investments, and the Law on Guarantees and Measures for the protection of foreign investors' rights. The judicial system of Uzbekistan consists of the Constitutional Court, courts of general jurisdiction for civil and criminal cases, economic courts, and military courts. The main act regulating and establishing the procedure for organization and activity of courts is the Law on Courts (new edition) dated 14 December 2000.[146]

The alternative dispute resolution institutions of Uzbekistan include the arbitration courts and the mediation system. The Tashkent International Arbitration Centre (TIAC) was established in 2018 and it offers impartial and fully neutral dispute resolution services to Uzbek and international parties. Businesses and individuals can apply for arbitration if they have a relevant dispute settlement clause in their contract or a separate arbitration agreement.[147] The Civil Procedural Code and the Economic Procedural Code also have provisions that regulate arbitration.

5. Renewable energy development scenario and observations

Uzbekistan has high RE potential as indicated in **Table 2.13**. The country is endowed with 2018 primary energy consumption.[148] The RE potential for other options is relatively smaller in comparison: 1,800MW of small hydropower, 1,600MW of wind power, and 800MW of bioenergy.

According to Ministry of Energy (minenergy.uz) estimates, Uzbekistan would need to generate 1.8 times more electricity[3]in 2030 than the country generated in 2018 to 2019. To achieve such generation targets, the country introduced the *Programme for the Implementation of Major Investment Projects in the Electric Power Industry for 2019-2030*. Under this program, the Ministry planned to introduce 15.6GW of new thermal power plants by 2030. In addition, 6.4GW of outdated equipment at various thermal power plants would have been decommissioned.[149] According to the *Strategy on the Transition of the Republic of Uzbekistan to the Green Economy for the Period 2019-2030*, Uzbekistan aims to increase the share of RE generation in total electricity generation to about 25 percent by 2030.

In 2019, investment in RE projects was driven by a few large organizations, with a total investment of USD4.6 billion in solar energy, USD500 million in wind energy, and USD2.6 billion in hydro projects. The details of these investments are provided in **Table 2.14.**

The development in RE in Uzbekistan has been held back by a few regulatory and market barriers including the following:

- According to International Energy Agency (IEA), the cost of producing electricity through non-renewable/traditional energy sources in Uzbekistan was cheaper than producing electricity through RE sources. Short term RE system profitability in particular was lower compared to the traditional energy system. Since there was no local RE technology manufacturing in Uzbekistan, the purchase, installation, and maintenance costs remained high.[150]

- Uzbekistan has offered high fossil fuel subsidies and had maintained low electricity end use prices, which reduce the competitiveness of renewable options, and consequently the RE projects are not considered bankable.

- It is significant to notice that the Uzbekistan Som depreciated about 377 times against the US dollar since the Som was adopted in July 1994. By the end of October 2019, one US dollar was equal to 9,424 UZS. Thus, international investors used foreign currency settlements to deal with the wildly fluctuating exchange rates.[151]

- Uzbekistan is the seventh largest producer of Uranium in the world. The country proposes to use this availability of Uranium to increase nuclear power generation to 15 percent by 2030. Over the years, Uzbekistan appeared more inclined towards developing nuclear power than RE, since the cost of producing energy from RE was considered to be 20 times costlier than producing energy from nuclear power plants.[152] The country was working with the Russian Federation in constructing the country's first nuclear power plant.[153] The International Atomic Energy Agency (IAEA) had approved

[3]The present study has modelled regionwide demand growth at 2.4 percent compound annual growth rate (CAGR) from 2018 to 2030.

the construction of four nuclear power plants in Uzbekistan,[154] two of which were proposed for commissioning by 2030.

- The Ministry of Energy oversees the RE related operations. Despite recent developments in the RE sector, given the end use tariff structure and the uncertainty in currency exchange rates, Uzbekistan is believed to lack the legal framework that could help provide incentives to promote RE deployment.[155] Although the country introduced a law which governs the implementation of RE projects in the country, the institution of a specialized agency to regulate and monitor the RE sector might provide the requisite focus.

6. Energy efficiency

Uzbekistan's RISE score was 65, which was higher than the world average and it was ranked third in the CAREC region after China and Kazakhstan. At 62, the country's EE score was the highest in Central Asia and scored second in the CAREC region after China.

The regulatory framework on EE in Uzbekistan covers 11 areas:

1. National EE planning
2. Energy efficiency entities
3. Incentives and mandates: commercial and industrial end users
4. Incentives and mandates: public sector
5. Incentives and mandates: utilities
6. Financing mechanism for EE
7. Minimum EE performance standards
8. EE labeling systems
9. Building energy codes
10. Transport sector
11. Carbon pricing and monitoring

Taking into account the growing demand for energy resources and high energy intensity of the Republic of Uzbekistan, one of the main directions of the state policy at this stage was to increase the EE of the economy through the creation of economic mechanisms to stimulate the rational use of electrical energy by consumers.

To improve EE, Uzbekistan has adopted a number of regulations; the core regulations are:

- Law of the Republic of Uzbekistan 'On electric power industry' from 30 September 2009, No. 225
- Law of the Republic of Uzbekistan 'On rational use of energy' dated 25 April 1997, No 412-I
- The Law of the Republic of Uzbekistan 'On rational energy use' defines the general legal framework, conserving national energy resources, energy efficiency, and potential production

The following are the government strategies to achieve EE targets:

1. **Strategy for action on five priority development areas in 2017-2021** (Decree of the President of Uzbekistan No. UP-4947 from 07 February 2017) with the priorities to reduce energy and resource intensity of the economy, wide introduction of energy saving technologies into production, expansion of RES, increase of labor productivity in the sectors of the economy

2. The **Program of Measures of Further Deployment of Renewable Energy and Improvement of Energy Efficiency in the Economic and Social Sphere 2017-2021** (Decree of the President of Uzbekistan No. 4422 from 22 August 2019) aims at reducing the energy intensity by 8 percent to 10 percent annually in key economic development sectors. It envisages decreasing energy intensity (energy per GDP) consumption by approximately two times as a result of the broad introduction of advanced energy saving technologies for the period 2017 to 2030; replacement of 17,251 heating boilers in 6,333 organizations with savings of more than 56.5 million m^3 of natural gas; replacement of 1,523 energy intensive electric motors, and 879 water pumps of the Ministry of Agriculture with energy savings of 807.3 million kWh of electricity. From 2016 household electric appliances not corresponding to energy efficient standards could not be imported to the Republic of Uzbekistan and existing appliances were to be phased out.

   Protocol decisions of the Republican Commission on EE and Development of Renewable Energy Sources established by the decree from 15 October 2019. No. 33, dated 23 December 2019, No. 42 approved the following:

   - The list of facilities of state and economic management bodies, which are to be equipped with renewable energy units, other energy efficient equipment in 2020, as well as work on improving thermal protection. The list includes 1,092 activities as a result of which the annual effect (savings) from implementation will amount to 66,900 tons of fuel equivalent. The preliminary cost of projects is about 353.5 billion soums.

   - According to the operative information of the ministries and agencies, the implementation of planned measures on the introduction of renewable energy sources, equipping with other energy saving equipment in the first quarter of 2020 allowed a saving of 39.0 million kWh of electricity, 186.9 million m^3 of natural gas, and 3,000Gcal through the thermal protection of buildings. Energy efficiency achieved as a result of these activities is 97,300 tons of fuel equivalent, estimated cost of projects is 29.7 billion soums, including 13.2 billion soums from own funds of ministries, departments, enterprises and 16.5 billion soums from loans of commercial banks.

3. Strategy for the transition of the Republic of Uzbekistan to the green economy for the period 2019-2030 (PP-4477 from 4 October 2019). Among the others, the main EE objectives are:
   1. Double the EE indicator and reduce carbon intensity of GDP

   2. Modernization of infrastructure of industrial enterprises, ensuring their sustainability by increasing energy efficiency by at least 20

percent and wider application of clean and environmentally friendly technologies and industrial processes

3. Expansion of production and use of motor fuel and motor vehicles with improved energy efficiency and environmental friendliness characteristics, as well as development of electric transport

By Decree No. 86 of 9 April 2015 on Implementing of Mandatory Energy Efficiency Labeling for Domestic Appliances and Electrical Devices and Newly Built Buildings and Structures introduces EE classes of household electrical appliances are introduced. It is prohibited to import household electrical appliances with 'G' and 'F' EE classes. Access to the market of Uzbekistan for household product with the 'E' energy efficiency class were to be prohibited starting from 1 January 2019 as well.

Although Uzbekistan has introduced EE classes and mandatory labeling for major residential appliances, it remains unclear how effective this regulation is. The decree does not define technical standards that set energy performance limits for end use categories and does not specify testing procedures to assess compliance with such standards.[156] However, local manufactures have adopted EU standards for EE labeling.[157] Further electricity savings in the residential and public building sector could be achieved through better insulations and retrofitting. A study on EE investment potentials in public buildings estimates power savings at 103GWh of electricity based on the current building stock.[158]

7. Review of the framework in Uzbekistan

- Uzbekistan could benefit immensely from defining a clear legal framework that could help provide incentives to promote RE deployment. Tariffs set by the Ministry have remained significantly below the levels that would be consistent with full cost recovery for the utilities concerned.
- Energy efficiency decrees need to define technical standards that set energy performance limits for end use categories and specify testing procedures and baselines to assess compliance with such standards.

Table A10: **Installed electricity generation capacity in Uzbekistan in 2020**

Technology	Capacity (MW)	Percent share
Non renewables	14,032	87.00
Renewable	2009	13.00
Hydro/marine	2005	12.00
Solar	4	0.00
Wind	1	0.00
Bioenergy	0	0.00
Geothermal	0	0.00
Total	16,041	100

Source: IRENA (29 September 2021). Energy profile: Uzbekistan. Retrieved on 15 October 2021 from https://www.irena.org/IRENADocuments/Statistical_Profiles/Asia/Uzbekistan_Asia_RE_SP.pdf

Table A11: Power export and import by Uzbekistan in GWh

Country	Year	2015	2016	2017
Kyrgyzstan	Export	9.9	3.3	3.7
	Import	9.3	5.8	1,218.0
Afghanistan	Export	1,288.5	1,497.8	1,850.8
	Import	0.0	0.0	0.0

Source: ADB, ESCC (2018) 'TA 9365: Regional cooperation on renewable energy integration to the grid: Dispatching Operation Practice Assessment Annex to Report for Output 1—task b/', pp68-70.

Table A12: Electricity tariffs in Uzbekistan

USD/Uz soum rate		**3958,56** 28.06.2017	**8100,00** 02.09.2017
	Price **UzS per kWh**	Price **USD per kWh**	Price **USD per kWh**
Consumer group			
I. Industrial and equated to them consumers with connected capacity 750kVA and above:			
Two part tariff:			
for 1kW of maximum load per year	336. 000	84.879	41.481
for 1kWh of consumed energy	158.10	0.04	0.0195
II. Industrial and equated to them consumers with an attached capacity of 750kVA			
Single rate tariff			
III. Agriculture/rural production, incl. pumping stations, financing from the state budget	204.30	0.052	0.0252
IV. Electrified railroad and city transport	204.30	0.052	0.0252
V. Non-industrial consumers, budget organizations, street lighting of cities	204.30	0.052	0.0252
VI. Trade organizations, cafes, restaurants, and services	204.30	0.052	0.0252
VII. Population, settlements for 1kWh	**204.30**	0.052	0.0252
The population of apartment houses equipped with electric stoves	102.15	0.026	0.0126
VIII. Electric energy used for heating, hot water and cooling (conditioning)	215.60	0.054	0.0266
IX. Advertising and illumination	215.60	0.054	0.0266
X. For auxiliary needs of energy system (Uzbekenergo)	204.30	0.052	0.0252

Source: Golden Pages Site (2019). Electricity tariffs in Uzbekistan. Retrieved on 14 October 2021 from https://www.goldenpages.uz/electroenergy/

Table A13: RE potential in Uzbekistan

RE source	Capacity (MW)	Target 2025 (MW)	Target 2031 (MW)
Small Hydro	1,800	1,240	
Solar	593,000	450	4,000
Wind	1,600	302	
Bioenergy	800		

Source: UNDP (2012) 'Renewable Energy Snapshot: Uzbekistan' http://www.eurasia.undp.org/content/dam/rbec/docs/Uzbekistan.pdf; Leader Associates (2019), 'Investing Renewable Energy in Central Asia,' White Paper Page 11. https://www.leader-associates.com/featured/Investing-Renewable-Energy-in--Central-asia Retrieved on 14 October 2021.

Table A14: Investments in RE in 2019

Type	Company	Capacity (MW)	Investment (USD million)
Solar	SkyPower Global	100	130
	SkyPower Global	200	260
	SkyPower Global	300	260
	SkyPower Global	400	350
	Graess Group	2,000	Under process
	Headwall Power	1,000	1,300
	CIRI (Beijing) Information Technology Co	2,000	2,000
Wind	Etko Co EnerjiA.S	600	500
	Uzbekenergo&PJSCMasdar	500	Under process
Hydropower	New constructions (24 projects)	637	2,039
	Modernization (18 projects)	588	610

Source: Leader Associates (2019), 'Investing Renewable Energy in Central Asia,' White Paper Page 12, https://www.leader-associates.com/featured/Investing-Renewable-Energy-in--Central-asia Retrieved on 14 October 2021.

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