YEOJU TECHNICAL INSTITUTE IN TASHKENT
CENTRAL ASIAN JOURNAL OF STEM
http://stem.ytit.uz/

TRANSITION FROM FOSSIL FUELS TO RENEWABLE ENERGY IN UZBEKISTAN

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Abstract

The viewpoint of Uzbekistan's energy system is examined in this thesis. The current statistics on the Uzbek energy system is complicated since some people simply include power generation, while others examine transportation, home resources, district heating, and the energy resources utilized to deliver these goods. Another impediment to studying the Uzbek energy system is the always-positive perspective of past studies. Neither the system's decision-makers nor scientists examine present situations with a critical eye. Indicators are inflated to state-by-state proportions, and events are explained solely from a positive perspective; yet, there is very little opportunity for positives when contrasted to negatives. Uzbekistan is a country that is energy self-sufficient and has a good overall energy balance. After the breakup of the Soviet Union, Uzbekistan was the only country to increase natural gas output by 35 percent. The temporal span of proved reserves is estimated to range from 35 to 55 years in the most optimistic scenario. Other fossil fuels have a lower part of the market, with 7 and 8% for oil and coal, respectively. Oil output is expected to fall somewhat, while coal production is expected to improve slightly. Hydropower generation has hit its peak and is unlikely to grow much. In Uzbekistan, nuclear energy is not used. In the next fifty years, it is expected to be Uzbekistan's primary source of energy. Fossil fuels will run out in less than fifty years due to significant growth in production and net exports.

1. Introduction

We are witnessing a turn in the energy industry, when non-traditional sources are moving from the category of exotic, previously only subjects of scientific interest, to statistically tangible categories of energy. It should be noted that in the context of the globalization of the world economy, the reduction in the growth of non-renewable energy resources, increased competition in the world markets for liquid hydrocarbons and solid fuels, the search for and widespread involvement of new alternative energy sources is becoming increasingly important to ensure sustainable economic development. By the beginning of the 21st century, with the economic development of countries, there was an excessive increase in energy

consumption, especially generated by thermal power plants, thermal power plants and internal combustion engines that use fossil fuels, which are increasingly “multiplicating” at a high rate, which led to an increase in the negative impact of their emissions on the environment. The global increase in the temperature of the Earth's atmosphere, scientists attribute emissions in a huge number of combustion products of thermal power plants and vehicles, running on fossil fuels. Today, the volume of annually burned fossil fuels in the world equals the equivalent of 12 billion tons of oil, or 2 tons of oil equivalent for each person on the planet. Over the past 40 years, the volume of produced fossil fuels in the world has exceeded the volume of its extraction in the entire previous history of mankind, which has led to a sharp reduction in its reserves. In recent years, the sharp increase in prices for hydrocarbon raw materials in many countries has made people think about new alternative types of energy sources, as a result, the total capacity of photovoltaic plants installed in European countries, especially the production of these stations in the Middle East countries, has doubled. The total area of solar collectors in the United States has reached 15 million square meters. m2, in Japan 12 million m2. Israel has about 1 million solar energy installations, providing 75% of the country's total hot water supply. The use of wind energy is also developing rapidly, the annual growth of their use in European countries is 40-45%. Experience with renewable energy installations shows that they generally pay for themselves, despite high costs for their acquisition and use in the initial period of operation. To date, a number of countries have adopted programs for the development of the use of renewable energy sources. For example, in Germany, by 2050, it is planned to increase the share of renewable energy sources to 50% in the country's total energy balance. The economy of Uzbekistan is very energy intensive by international standards. The index of GDP per unit of energy consumption (in constant 2005 PPP prices in US dollars per 1 kg of oil equivalent) for Uzbekistan in 2009 was equal to 1.5 US dollars per kg of oil equivalent. For comparison, the same indicator in the same year for Russia - 3, Turkmenistan - 1.7, USA - 5.9, Switzerland - 10.6, Singapore - 12.5, Indonesia - 4.3.1 This is due to the use of technologically outdated equipment, a high share of fuel and energy resources in the production of goods, in the country's exports, relatively low prices for electricity and some types of fuel, an inadequate accounting system for the production and consumption of electricity and energy resources, etc. Most power plants were built in Soviet times and the technology and equipment at many power plants is outdated and less efficient than modern technologies and equipment. The efficiency of the equipment used in many power plants is low by international standards. At the same time, with the aging of equipment, its efficiency decreases, and it requires more operating costs for operation.

Many power lines are also outdated and the power losses in them exceed the allowable values. The same situation is observed in distribution points. Due to limited financial resources in the past, Uzbekenergo was unable to allocate adequate funding to the energy sector in order to carry out the necessary maintenance, reconstruction, replacement and expansion of the energy sector. Currently being implemented, and in the near future it is planned to implement a large number of

investment projects in the electric power and oil and gas sectors to modernize existing capacities and the introduction of new efficient technologies in the process of energy production and transmission, which contribute to energy efficiency in these industries. In order to support the growth of the country's GDP and in order to meet the needs of consumers in a reliable and uninterrupted energy supply, significant investments are required to upgrade, replace and increase the capacity of the energy supply infrastructure. The state understands this problem and, given the increase in demand for energy resources in the future, in order to ensure the associated And balanced development of energy capacities, the most important priority for the socio-economic development of the energy industry in the short term is to continue reforming the electric power industry and the coal industry, accelerating the implementation of investment projects for further development and modernization energy enterprises based on the introduction of new technologies and equipment.

1.2. Socio-economic background.

By the time of the beginning of the territorial expansion of the Russian Empire on the territory of modern Uzbekistan, there were three states of the formation of the Emirate of Bukhara, the Kokand Khanate and the Khiva Khanate.

In 1876, the Kokand Khanate was defeated by the Russian Empire, the Khanate was abolished, and the central territories of the Khanate became part of the Fergana region. By the beginning of the 20th century, Central Asia was part of the Russian Empire and at the beginning of the formation of Soviet power, despite the resistance of the Bolsheviks, all of Central Asia became part of the Soviet Union, from the Turkestan ASSR, the Bukhara Republic and the Khorezm Republic after the national-territorial demarcation on October 27, 1924 were formed by the Uzbek Soviet Socialist Republic with its capital in the city of Samarkand.

On September 1, 1930, the capital of the Uzbek SSR was moved from Samarkand to Tashkent. Thanks to the initiative of President I.A. Karimov, on August 31, 1991, the independence of Uzbekistan was proclaimed. On August 31, 1991, the Supreme Council of Uzbekistan adopted a resolution “On the declaration of the state independence of the Republic of Uzbekistan”, as well as the Law “On the foundations of the state independence of the Republic of Uzbekistan”. The Uzbek SSR was renamed the Republic of Uzbekistan.

As of January 1, 2012, the population of the country was 29,559,100 people, of which 51% are urban and 49% are rural. The average population density is 65.8 people. for 1 sq. km. In terms of the number of inhabitants, Uzbekistan ranks third among the CIS countries after the Russian Federation and Ukraine. However, unlike the latter, Uzbekistan has a high birth rate and positive population growth. In 2011, the population growth amounted to 435.7 thousand people or 1.5%. There are 120 cities and 115 urban settlements in the republic; in them in total, 15,069,600 people live, or about 51% of the total population.

The state language of the Republic of Uzbekistan is the Uzbek language. The second most important Russian language. It is known by a significant part of the population, and it is widely used in the country.

Cotton, wheat, vegetables and fruits are the main agricultural products. Nearly all agriculture requires irrigation, and irrigation is done with mains-powered canals and irrigation pumps. The mining industry also accounts for a significant share of production and this industry is also dependent on a reliable source of electricity. Gold, along with cotton, are the main sources of foreign exchange earnings. Uzbekistan also has reserves of copper, lead, zinc, tungsten and uranium. The industry of Uzbekistan includes the textile industry industry, mining, automotive and aviation industries. All of these industries need a reliable power supply to produce their products. Uzbekistan also has significant mineral resources.

In terms of gold reserves, the republic ranks fourth in the world, and in terms of its extraction - seventh place (about 80 tons of gold annually), in terms of copper reserves - tenth-eleventh place; uranium - the twelfth place, and in terms of its production - the seventh place. Uzbekistan ranks twelfth in the world in terms of uranium reserves and seventh in its production. At the moment, about 40 deposits with uranium reserves have been explored in the country, the core of which is 27 deposits. According to the information center of the State Committee for Geology and Mineral Resources of the Republic, explored and estimated uranium reserves amount to 185.8 thousand tons. The Republic does not have its own nuclear industry; all low enriched uranium produced is exported). A powerful mineral resource base has been created in Uzbekistan, which is one of the main items of foreign exchange earnings in the country's economy.

Today this base consists of more than 1800 fields and about 1000 prospective manifestations of minerals, 118 types of mineral raw materials, of which 65 are in development. The mineral resources of Uzbekistan are estimated by experts at about 3.5 trillion dollars.

Developed cotton market. In 2011, a record grain harvest was harvested (about 6.8 million tons). Significant untapped oil and gas reserves. Current gas production makes a decisive contribution to electricity production.

The only aircraft building plant in Central Asia is located in the Republic of Uzbekistan. In the city of Asaka, Andijan region, there is a large plant "GM Uzbekistan", which produces cars under licenses.

Daewoo and Chevrolet.

211 hydrocarbon deposits have been discovered in five oil and gas regions of Uzbekistan. Of these, 108 gas and gas condensate, 103 oil and gas, oil and gas condensate and oil. More than 50% of the fields are under development, 35% are prepared for development, and exploration work continues at the rest.

The volume of annual hydrocarbon production in Uzbekistan is about 86 million tons of standard fuel. Since 1991, its level has increased by more than 60%.

Geological oil reserves - 5 billion tons.

Proven oil reserves - 530 million tons.

Geological reserves of natural gas - more than 5 trillion. m³.
Proved reserves of natural gas amount to 3.4 trillion m³.
Oil production - 3.5 million tons per year.
Natural gas production - 62.9 billion m³.

Uzbekistan currently ranks 8th in the world in terms of natural gas production. Uzbekistan has a very large untapped gas potential, and is currently one of the largest gas producers, but it does not have access to the Caspian Sea, although it is on the Central Asian route, to which it supplies approximately 10 billion m³ per year. The results achieved in the development of the country'seconomy in recent years and in the past year are highly appreciated by authoritative international financial institutions, such as the International Monetary Fund, the World Bank, the Asian Development Bank, and others. In its statement on the results of the latest assessment mission of the International Monetary Fund, in particular, it is noted that "Uzbekistanhas achieved dynamic growth and coped well with the global financial crisis. Over the past five years, Uzbekistan's Growth rate has been 8.5 percent, above the Central Asian average. Years of stable budget surpluses, high levels of official reserves, low public debt, a stable banking system, and prudent borrowing in international financial markets have protected the country from the direct effects of the global global crisis.

The GDP growth rate in 2011 was 8.3%, and for the period 2000-2011, the volume of GDP increased 2.1 times, and according to this indicator, Uzbekistan is among the most dynamically developing economies in the world. In 2011, the production of industrial products increased by 6.3%, agricultural products - by 6.6%, the volume of disbursed capital investments - by 11.2%, the volume of paid services by 16.1%, retail trade turnover - by 16, 4 %. An indicator of serious structural shifts and qualitative changes is the fact that if in 2000 the share of industrial production in the formation of the country's gross domestic product accounted for only 14.2 percent, then in 2011 it amounted to 24.1 percent.

The volume of product exports increased in 2011 by 15.4%, finished products account for about 60% of total exports. The real sector attracted foreign investments in the amount of almost 2.9 billion dollars. The most important agricultural products of Uzbekistan, in addition to cotton, are fruits, vegetables and grains (wheat, rice and corn). The main energy resources of the state are natural gas (proven reserves up to 3.4 trillion m³, including the large Shurtan - 0.5 trillion m³ and Alan - 0.2 trillion m³ fields, the large Urga field has been explored with reserves up to 1, 5 trillion m³), coal (Angren deposit with reserves of up to 1.9 billion tons of brown coal), reserves of uranium ores (total up to 230 thousand tons of uranium, including the largest - Uchkuduk deposit) and hydropower (Chirchik river , Akhangaran (Angren), Surkhandarya and many small ones).

1.3. Political situation.

Uzbekistan is a democratic republic. The Republic of Uzbekistan gained independence on August 31, 1991. September 1, 1991 - Independence Day of the

Republic of Uzbekistan. On July 1, 1994, the national currency, the sum, was introduced. On December 8, 1992, the Constitution of the Republic of Uzbekistan was adopted. The head of state is the president. The system of state power of the Republic of Uzbekistan is based on the principle of separation of powers into legislative, executive and judicial. The highest state representative body is the Oliy Majlis of the Republic of Uzbekistan, which exercises legislative power. The Oliy Majlis of the Republic of Uzbekistan consists of two chambers - the legislative chamber (lower house) and the Senate (upper house). The term of office of the Legislative Chamber and the Senate of the Oliy Majlis of the Republic of Uzbekistan is five years.

In the Republic of Uzbekistan, public life develops on the basis of many political institutions, ideologies and opinions. No ideology can be established as a state one. The President of the Republic of Uzbekistan is the head of state and ensures the coordinated functioning and interaction of public authorities. The President of the Republic of Uzbekistan is elected by the citizens of the Republic of Uzbekistan on the basis of universal, equal and direct suffrage by secret ballot for a period of 5 years. According to Article 9 of Chapter II of the Constitution, the most important issues of public and state life are submitted for discussion by the people, submitted for universal suffrage (referendum). The procedure for holding a referendum is determined by law. The Legislative Chamber of the Oliy Majlis of the Republic of Uzbekistan consists of one hundred and fifty deputies elected in accordance with the law. The Senate of the Oliy Majlis of the Republic of Uzbekistan is a chamber territorial representation and consists of members of the Senate (senators).

Members of the Senate of the Oliy Majlis of the Republic of Uzbekistan are elected in equal numbers - six people each - from the Republic of Karakalpakstan, regions and the city of Tashkent by secret ballot at the relevant joint meetings of deputies of the Jokargy Kenes of the Republic of Uzbekistan. Republic of Karakalpakstan, representative bodies of state power of regions, districts and cities from among these deputies. Sixteen members of the Senate of the Oliy Majlis of the Republic of Uzbekistan are appointed by the President of the Republic of Uzbekistan from among the most authoritative citizens with extensive practical experience and special merits in the field of science, art, literature, production, and other areas of state and public activity.

1.4. Ecological situation.

The formation of a perfect system of environmental security based on international legal experience, the achievements of modern science, engineering and technology is one of the fundamental conditions for ensuring the national security of Uzbekistan. Environmental security is a strategic component of national security, the most important aspect of protecting the vital interests of the state, society and the individual in the Republic of Uzbekistan.

The environmental security policy of the Republic of Uzbekistan is carried out on the basis of the Constitution, legislation, the National Security Concept of the

Republic of Uzbekistan, the principles of the Rio de Janeiro and Johannesburg declarations on the environment and sustainable development, taking into account the obligations of the republic arising from international conventions and agreements, as well as legislative experience leading states. Uzbekistan, like all countries of the post-Soviet space, inherited an economy with energy- and material-intensive production, outdated and polluting equipment and technologies. In the context of the transition from a command economy to a market economy, the optimal combination of macroeconomic planning with environmental policy and its integration with social and other policies has become of paramount importance. The environmental policy of the republic is aimed at the transition from the protection of individual elements of nature to the general protection of ecosystems, guaranteeing the optimal parameters of the environment for human life.

An assessment of the consequences of global and regional climate change on the territory of Uzbekistan shows that by 2030 a possible increase in average annual temperatures will be 2-3 degrees in the northern zone and 1 degree in the southern zone of the republic, less significant impacts are expected in mountainous areas. Precipitation is expected to increase throughout Uzbekistan from 5-15% in the Ferghana Valley to 15-20% in the northern part of the republic. Climate change will lead to an increase in water losses by 10-15% due to evaporation from the water surface and by 10-20% due to an increase in transpiration by plants, which will cause an increase in irretrievable water consumption by an average of 18% with a corresponding increase in water withdrawal.

Over the past 40-45 years, the level of the Aral Sea has decreased by more than 22.0 m, the area of the water area has decreased by more than 3.8 times, the volume of water has decreased from 1064 to 115 km 3, the salinity of the water has reached 72 g / l. The Aral Sea has practically turned into a "dead" sea. The area of the dried bottom amounted to 4.2 million hectares and became a source of sand-salt aerosol removal to the adjacent territories. Dust plumes reach 400 km in length and 40 km in width, and the radius of action of dust storms is up to 300 km. Every year, from 15 to 75 million tons of dust rises into the atmosphere here. Since the early 1980s, such storms have been observed here 90 days a year.

1.5. Overview of the energy sector.

There is no energy regulator in Uzbekistan. The functions of price and tariff regulation are distributed among several state bodies. In practice, the Pricing Department under the Ministry of Finance of the Republic of Uzbekistan sets tariffs for all types of energy.

NHC Uzbekneftegaz is a vertically integrated three-level holding responsible for managing the entire oil and gas sector of Uzbekistan, established in 1988. The branch unites more than 190 enterprises. Uzbekneftegaz includes 6 joint-stock companies:

- Joint Stock Company "Uzgeoburneftegaz" Carries out exploration, exploration and production drilling of oil and gas wells;

- Joint Stock Company "Uzneftegazdobycha" Engaged in the development of oil and gas fields, production of oil, gas and gas condensate, processing of natural gas;

- Joint Stock Company "Uztransgaz". It carries out transportation and underground storage of gas, manages the facilities for transporting natural gas from Uzbekistan to consumers of the republic and exporting it outside the republic, as well as ensuring the transit of natural gas from neighboring countries. To ensure its activities, it carries out the construction and overhaul of gas transmission system facilities. Provides the population of the republic with natural gas;

- Joint Stock Company "Uznefteprodukt" It is a 100% owner of the property of the Ferghana, Altyaryk and Bukhara oil refineries of the republic, which process oil and gas condensate, as well as sell oil products to the sectors of the economy and the population of the republic, owns a network of oil depots, transshipment terminals and gas stations, controls the activities of enterprises for sales of petroleum products on the domestic market of Uzbekistan;

Joint-stock company "Uzneftegazstroyinvest" Performs design work, capital construction and arrangement of facilities for production, transport, oil and gas processing; - Joint Stock Company "Uzneftegazmash". Subsoil of Uzbekistan has large reserves of hydrocarbons. It should be noted that Uzbekistan has developed a strategic program of exploration for oil and gas, designed for the period 2005-2020, which provides for an increase in hydrocarbon processing over this period in the amount of 1.15 billion tons. conditional fuel. At the same time, the main share of the increase in gas reserves falls on the Ustyurt region.

Since 2001, the electric power industry of the Republic of Uzbekistan has been operating within the framework of the State Joint-Stock Company Uzbekenergo, formed in the form of an open joint-stock company with the inclusion of coal industry enterprises in its structure.

SJSC "Uzbekenergo" is the governing body in the electric power industry and the coal industry of the most important structural components of the country's economy. The accelerated development of the fuel and energy complex has been a priority policy of the country's leadership since the first years of independence.

The energy strategy policy is aimed at ensuring energy independence and security, improving energy efficiency and reducing the negative impact of energy on the environment. To solve these problems, the latest technologies based on scientific achievements are being developed and implemented, providing safer, cleaner energy, an optimal energy balance structure, the introduction of advanced methods and principles of energy conservation management and, in general, increasing energy efficiency. efficiency of production and consumption of energy resources, including electricity. Based on the main task of sustainable provision of the economy and the population of the republic with energy and coal, pursuing a unified technical policy in the electric power industry, SJSC Uzbekenergo maintains the complexity of its structure, which allows it to carry out design, construction, installation, commissioning, service and repair work on its own. At this stage, the company includes 54 enterprises and organizations, including: 41 open joint stock

companies, 11 unitary enterprises and 2 limited liability companies. The energy system of Uzbekistan is the main link in the inextricable chain of production and transmission of electricity in the region. The strategic geographical position, the presence of developed networks allows us to successfully organize and be an active participant in the electricity and capacity market. The installed capacity of the republic's power plants is more than 12.4 million kW, including 12.0 million kW - the installed capacity of 39 thermal and hydroelectric power plants of the Uzbekenergo company. The remaining 300 megawatts are managed by government departments and industries.

The technical losses of electrical energy in the power grid economy of SJSC "Uzbekenergo" are approximately 13%, taking into account the technical losses of electrical energy of enterprises for the production of electric energy of main electrical networks and enterprises of territorial electrical networks. At the same time, the concept of “commercial losses” is absent in the current regulatory documents. In the structure of primary energy resources used for the production of electrical and thermal energy, gas fuel is 92%, fuel oil and coal - approximately in equal shares. Up to 3.6 million tons of coal are mined at the enterprises of the coal industry, and 222 million m3 of gas is produced through underground gasification. At present, the share of renewable energy sources in the country’s fuel and energy balance does not exceed one percent. At the same time, the renewable energy potential of Uzbekistan is about 51 billion tons of oil equivalent, the technical potential is more than 179,00.0 million tons of oil equivalent. Since 2021, prices for various industrial materials, as well as freight costs, have been rising, driving up the cost of wind turbines and solar panels. PV-grade polysilicon has more than doubled in price since the beginning of 2020, while steel has climbed by 50%, copper by 60%, and aluminum by 80%. Furthermore, freight fees have nearly doubled, resulting in increasing expenses for the renewables supply chain's geographically distributed supply network. The reversal of the long-term trend of reducing costs is already obvious in the pricing of wind turbines and PV modules, which have risen by 10-25 percent depending on nation and location, wiping out two to three years of cost reductions due to technological advancements since 2018. The exception is the People's Republic of China, where wind turbine costs continued to fall in 2021 as demand fell after the 2020 deployment boom, which was fueled by the anticipated phase-out of subsidies. Key commodities and freight expenses are estimated to account for around 15% of total utility-scale solar PV and onshore wind investment costs. The manufacture and transportation of the module, which is directly impacted by the price of polysilicon, steel, and aluminum, is the most expensive part of solar PV. The cost of an inverter and electrical installation is determined by the price of copper, while the cost of other components is affected by rising freight rates. Steel is the most expensive component of wind turbines, as it is utilized extensively in the fabrication and construction of the tower, nacelle, and mechanical equipment. Because heavy components must be transported using specialized ships, freight can account for up to 6% of total onshore wind investment expenses.

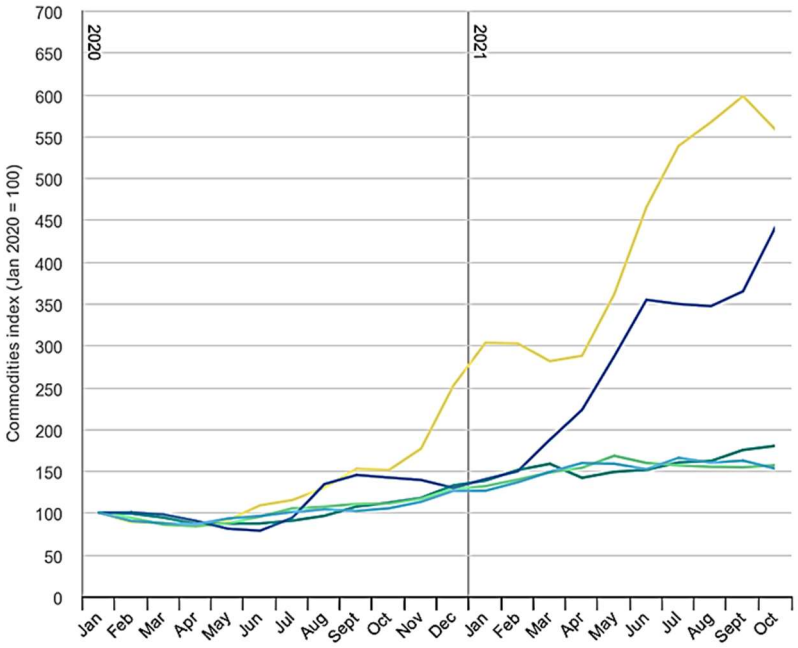

Fig 1. Monthly commodity and freight price indexes, 2020-2021[1]

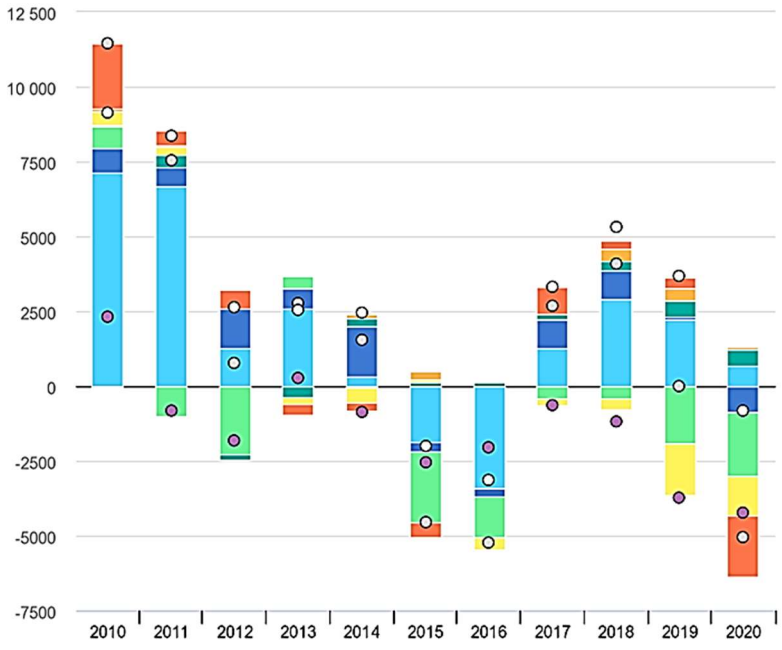

Fig 1. Coal consumption year-on-year growth rate, 2010-2020[2]

For wind, upfront capital and related finance expenses are 70-80% of the levelised cost of energy generation, while for solar PV, they are 80-90 percent. As a result, any increase in initial CAPEX has a significant impact on the investment's profitability. Based on a comparison of average commodity prices between 2019 and 2021, we predict that the entire investment cost of utility-scale PV and onshore wind facilities might rise by roughly 25% as a result of the commodity and freight price

[1] https://www.iea.org/articles/what-is-the-impact-of-increasing-commodity-and-energy-prices-on-solar-pv-wind-and-biofuels
[2] https://www.iea.org/articles/what-is-the-impact-of-increasing-commodity-and-energy-prices-on-solar-pv-wind-and-biofuels

increases. Commodity price increases do not immediately influence investment costs since developers, manufacturers, and other sections of the supply chain typically have goods on hand and have contracts based on past pricing. However, rising raw material and logistics prices have an impact across the whole value chain, potentially raising the cost of power provided by renewables. Manufacturers, equipment installers, and developers, for example, can absorb cost rises in a variety of ways, with some sectors being more affected than others. Developers might utilize additional hedging methods, cost sharing, or smart deployment of equipment to mitigate the impact of rising costs in the short term.

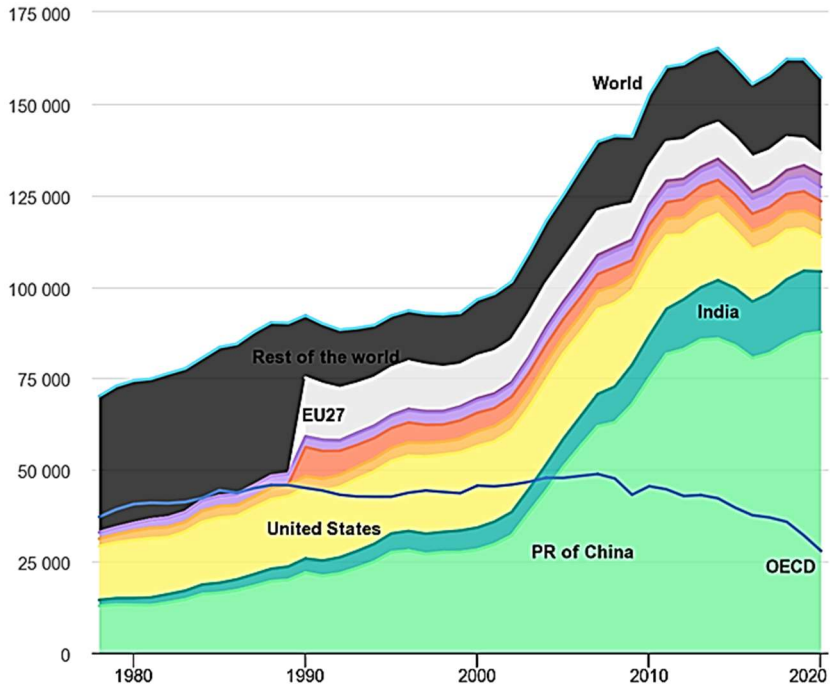

Fig 1. World coal consumption, 1978-2020[3]

In Q1 2021, greater costs resulted in fewer equipment purchases, as several manufacturers reported less orders as a result of higher input prices, forcing them to modify the price of their completed products. While sales grew in Q2 as purchasers adjusted to the new market conditions, rising demand was accompanied by a dramatic rise in polysilicon prices. Wind equipment manufacturers have reported decreased profits as a result of higher expenses, with some decreasing their profit estimate by 50%. Furthermore, several European and American wind turbine manufacturers have already announced price hikes for new orders ranging from 10% to 25%. While manufacturers are cutting freight costs by obtaining equipment from nations closer to their assembly hubs, increasing material prices may be seen downstream when manufacturers utilize hedging contracts to transfer commodity price risk to the buyer. China has not been spared the effects of rising commodity prices. Despite the fact that China produces over 80% of the world's modules, increasing commodity prices have increased the cost of solar PV systems in that

[3] https://www.iea.org/articles/what-is-the-impact-of-increasing-commodity-and-energy-prices-on-solar-pv-wind-and-biofuels

market. However, due to tight competition among suppliers left with manufacturing overcapacity after extraordinarily high deployment in 2020, Chinese wind equipment costs have achieved record lows in 2021.

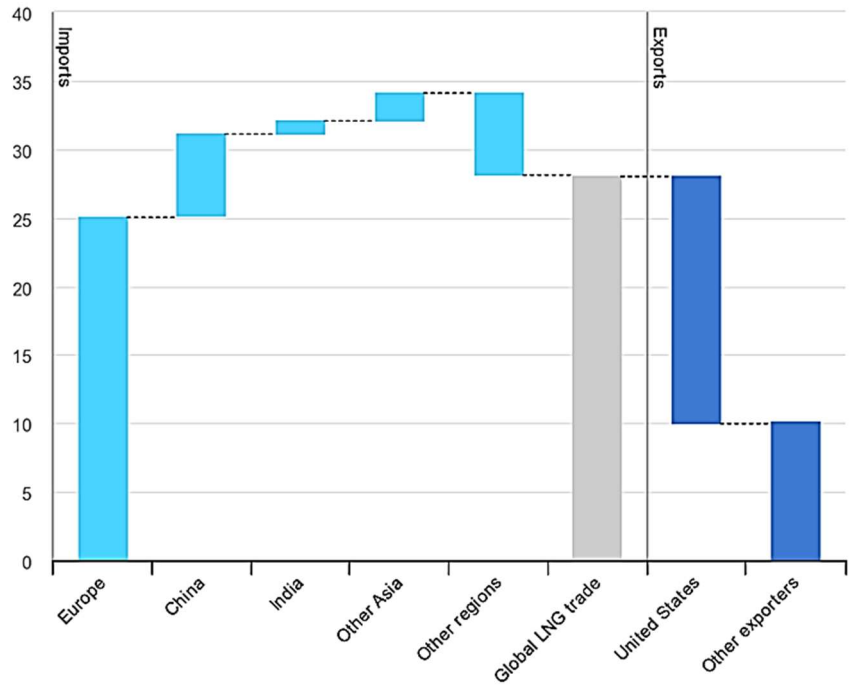

Fig 1. Global LNG balance, year-on-year change, 2021-2022[4]

Recent government-led competitive wind and solar PV auctions have already seen contract price increases partly due to high commodity and freight prices. In Brazil rising equipment prices have contributed to awarded prices being over 70% higher in 2021 auctions compared to those held in 2019. Nevertheless, the awarded prices are substantially below those awarded to natural gas-fuelled generation in Brazil's emergency reserve auction held in October. In India auction prices for solar PV in Q3 2021 were 16% above the historical lows reached in Q4 2020, which may result in delays in signing PPAs with utility companies. The most recent renewables auction in Spain resulted in prices nearly 30% higher than those awarded in January 2021 due, in part, to increases in the cost of materials. These auction prices are, however, well below current wholesale prices in the country. Nascent renewables markets are also seeing higher prices. In Colombia final contract prices for solar PV at the auction held in November 2021 were almost 45% higher than those awarded in 2019, with these increases partially caused by higher investment costs. Upward price trends for the equipment needed to build solar PV and wind power plants pose a challenge to developers who won bids in competitive auctions anticipating continuous declines in the cost of modules and turbines. The IEA estimates that around 100 GW of awarded but yet-to-be commissioned wind and solar PV capacity from 2019 and 2021 are at risk of the commodity price shock, potentially leading to

[4] https://www.iea.org/articles/what-is-the-impact-of-increasing-commodity-and-energy-prices-on-solar-pv-wind-and-biofuels

commissioning delays. A prolonged increase in commodity and equipment prices could result in developers withholding equipment purchases until prices return to lower levels. Meanwhile, auction organisers, utilities and companies purchasing renewable electricity could also be reluctant to accept higher tariffs, delaying their procurement plans, especially in emerging and developing markets.

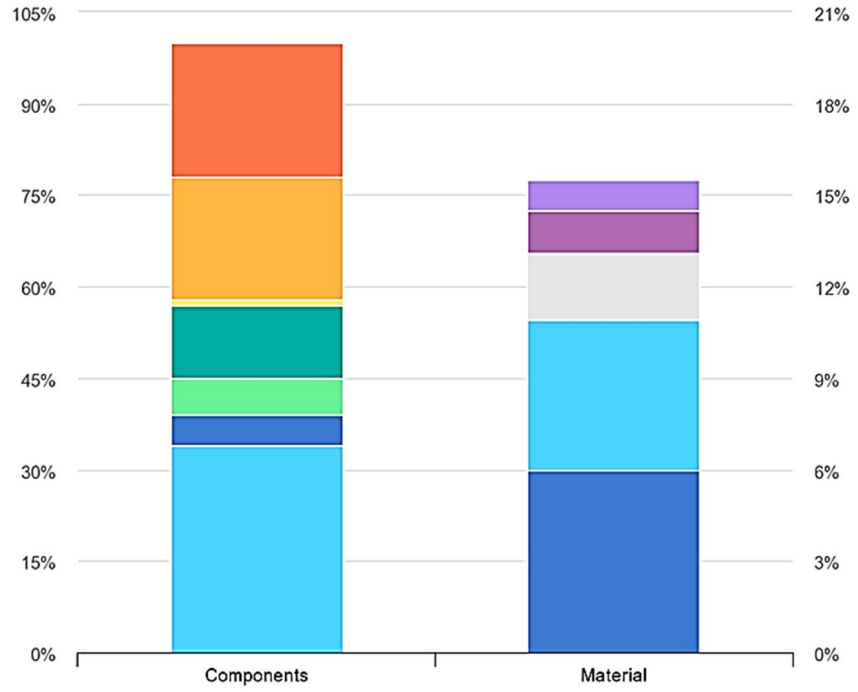

Fig 1. Utility-scale PV investment cost structure by component and by commodity breakdown[5]

Rising natural gas and coal prices have led average wholesale electricity prices to increase worldwide. In countries such as Germany, the United Kingdom and Spain, average wholesale electricity prices from January to October 2021 more than doubled compared with values observed in 2019 and 2020. Higher natural gas and coal prices have improved the competitiveness of wind and solar PV, despite historic equipment price increases due to high commodity and energy prices. For corporations, fixed-price renewable energy contracts have served as a hedge against higher spot market prices, increasing the value of such bilateral agreements. For governments, higher electricity prices are not translated into higher subsidies for wind and solar PV, as almost 90% of all wind and PV projects have long-term fixed-price PPAs either through FITs or CfDs. Recent government-led competitive wind and solar PV auctions have already seen contract price increases partly due to high commodity and freight prices. In Brazil rising equipment prices have contributed to awarded prices being over 70% higher in 2021 auctions compared to those held in 2019. Nevertheless, the awarded prices are substantially below those awarded to natural gas-fuelled generation in Brazil's emergency reserve auction held in October. In India auction prices for solar PV in Q3 2021 were 16% above the

[5] https://www.iea.org/articles/what-is-the-impact-of-increasing-commodity-and-energy-prices-on-solar-pv-wind-and-biofuels

historical lows reached in Q4 2020, which may result in delays in signing PPAs with utility companies. The most recent renewables auction in Spain resulted in prices nearly 30% higher than those awarded in January 2021 due, in part, to increases in the cost of materials. These auction prices are, however, well below current wholesale prices in the country. Nascent renewables markets are also seeing higher prices. In Colombia final contract prices for solar PV at the auction held in November 2021 were almost 45% higher than those awarded in 2019, with these increases partially caused by higher investment costs. Upward price trends for the equipment needed to build solar PV and wind power plants pose a challenge to developers who won bids in competitive auctions anticipating continuous declines in the cost of modules and turbines.

Conclusion

This paper review Uzbekistan's implementing large-scale reforms in recent years to strengthen its energy industry. Problems are associated with high wear and tear on equipment as well as with the slow pace of infrastructure updates, faulty equipment operations, inadequate installations, and both gas pipelines and power lines that have exceeded their service life. The country's unstable financial situation and inadequate introduction of resource- and energy-saving technologies have raised technological losses and made fuel and energy resource supply interruptions more frequent. Uzbekistan is one of the world's largest natural gas producers, annually producing

Biography

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