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UZBEKISTAN DECARBONIZATION ROADMAP

EFFECTIVE GOVERNANCE FOR ECONOMIC DEVELOPMENT (EGED)

Pillar 2: Accountability

Tashkent – May 2023

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Table of Contents

List of Abbreviations

RIA	Regulatory Impact Analysis
NPP	Nuclear power plants
RES	Renewable energy sources
GDP	Gross domestic product
WPP	Wind power plants
GW	Gigawatt - unit of power
SUE	State Unitary Enterprise
power	plant
kV	Kilovolt is a unit of voltage measurement.
kW/h	Kilowatt-hour – unit of electrical energy
MW	Megawatt is a unit of power
SHPP	Small hydroelectric power station
MJ	Megajoule - a unit of energy
SME/SME	Small, medium business or business
IEA	International Energy Agency
VAT	Value Added Tax
UN	United Nations
GHG	Greenhouse gases
UNDP	United Nations Development Program
CIS	Commonwealth of Independent States
TPP	Thermal power plant
FGD	Focus - group discussion
PES	Photoelectric power plants
PDG	Policy Dialogue Group
EE	Energy efficiency
EGED	Effective Governance for Economic Development Program
LTS	Long-term strategy for the decarbonization of Uzbekistan developed with the participation of the World Bank

Purpose of Uzbekistan Decarbonization Roadmap

Uzbekistan has one of the fastest growing economies in the Central Asian region and is one of the largest emitters of carbon dioxide. Primarily due to the widespread use of fossil fuels for power plants and outdated industrial processes. These emissions not only contribute to global climate change, but also lead to local air pollution, which can have serious consequences for the health of the population of Uzbekistan. Therefore, decarbonization efforts are needed to address these challenges and move towards a more sustainable and greener energy system.

Decarbonization is important for Uzbekistan in the context of sustainable development, and the state expressed its interest in this issue through the country's ratification of the Paris Agreement in 2018. In 2021, Uzbekistan increased its commitment to reduce specific greenhouse gas emissions per unit of GDP by 35% by 2030 from the 2010 base year. The current government reforms in the field of decarbonization are aimed at helping the country to transition to green energy sources, such as renewable sources, and improve energy efficiency in various sectors of the economy. The introduction of these measures helps to reduce dependence on fossil resources, improve the environmental situation and develop innovative technologies. In addition, decarbonization is expected to bring economic benefits such as increased energy efficiency and the creation of new green jobs.

This Roadmap serves as a means of communication, a document consolidating the opinion of a wide range of participants and stakeholders (in particular, representatives of civil society and the private sector involved in the development of the use of renewable energy and the growth of EE, production, import and export of this equipment , will represent scientific and university circles). The purpose of the "road map" is to create conditions for supporting the decarbonization process in Uzbekistan, by introducing renewable energy sources (RES) and energy efficiency (EE) technologies in the country's economy, increasing the consumption of clean energy from RES sources and reducing the use of carbon resources for energy production, which will contribute to the reduction of greenhouse gas emissions into the atmosphere. The developed document provides information that substantiates the relevance of the issue considered in this Roadmap, its relationship with national and sectoral priorities and international obligations.

This Roadmap is a development plan that defines the goals and desired outcome for decarbonization, expanding the use of renewable energy and increasing energy efficiency in Uzbekistan in the long term (until 2030) and includes the main steps or stages necessary to achieve it.

As part of the implementation of this initiative, a Decarbonization Policy Dialogue Group (PDG) was created[1], which included representatives of associations and groups of renewable energy producers, environmental activists, non-governmental non-profit organizations, representatives of the private sector and university circles interested and able to analyze the decarbonization process, contribute contribution to the development of the Long-Term Decarbonization Strategy of Uzbeks from Tana (LTS).

This Roadmap served as a kind of platform for the exchange of experience and opinions between the group members on the current state of decarbonization in the country, discussing the improvement of mechanisms for the introduction of green technologies and renewable energy described in the legislation of Uzbekistan. As a result of multilateral discussions, PDG developed recommendations to address the identified problems and implement effective measures to improve the current efforts of the state in the development of green technologies and reduce carbon dioxide emissions, which are presented in the second part of this Roadmap.

[1]More information on PDG work in Annex 2

PART I. BRIEF DESCRIPTION (OVERVIEW) OF THE AREAS OF IMPLEMENTATION OF THE ROADMAP

1. Introduction

1.1. Climate change and global decarbonization trends

Climate change is one of the most serious threats to the sustainability of the global environment, human health and well-being, and the global economy. Scientists have found that an increase in the average temperature of the Earth's surface has had a negative impact on the planet's ecosystem, jeopardizing the survival of the Earth and future generations.

The rapid development of the world economy in the last century has not only contributed to the improvement of the welfare of countries, but also left a huge ecological footprint. The increase in the scale of world production, the spread of all types of transport, the decrease in forest areas and much more have had a negative impact on the climate and the environment.

Due to the interconnectedness of natural processes in nature, the consequences of climate warming are numerous and varied: some of the most significant are the melting of glaciers, the rise in the level of the world ocean and its acidification, as well as the increasing frequency of extreme natural phenomena - floods, droughts and forest fires, typhoons and hurricanes.

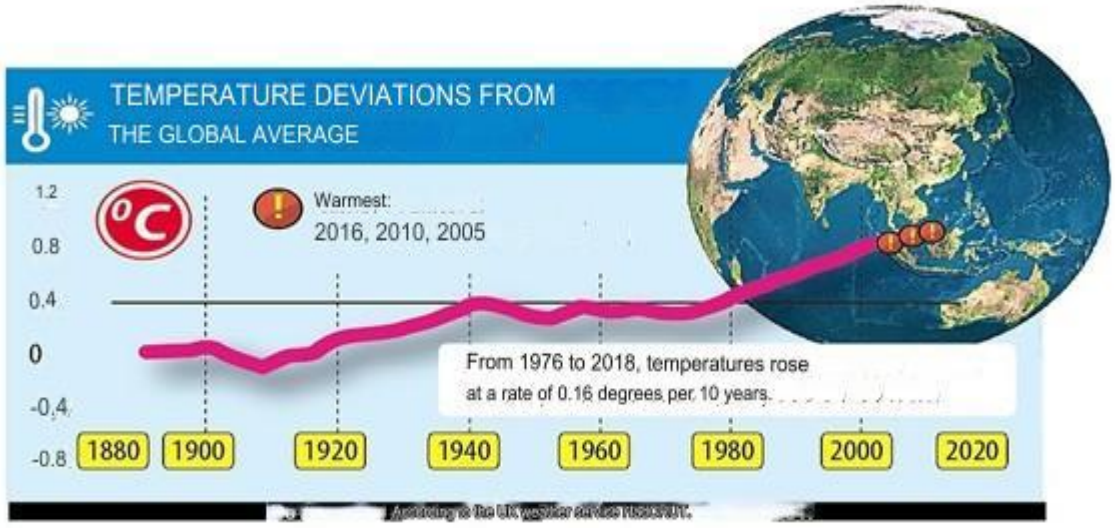


Figure 1. Global average temperature deviation

The Central Asian region is being adversely affected by a rapidly changing climate due to harsh and unique conditions – an arid climate, a landlocked location that draws much of its water from mountain glaciers upstream and nearby countries, extensively developing agriculture, an aging infrastructure, and rapidly population growth. Although the countries of the region - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan - have different landscapes, natural and climatic conditions, development priorities, the transboundary nature of climate risks equally affects each of the countries of Central Asia. The countries of the region are already facing some of them today: changing temperature and water regimes, higher maximum temperatures and longer duration of heat waves; spatial and seasonal shifts in precipitation regimes; an increase in extreme rains and droughts leading to land degradation, deteriorating water quality, desertification, dust storms and increasing pressure on infrastructure. Future warming will have a huge impact on the rate of glacier melt, local seasonal weather patterns and rainfall patterns affecting natural ecosystems, agriculture and human well-being.

Moving towards carbon neutrality and climate resilience; updating water and energy infrastructure to minimize climate risks, strengthening the capacity of local communities, implementing progressive regulatory and institutional reforms to attract the necessary investments - these are strategic tasks that

governments and their development partners in the Central Asian region must address. Unprecedented economic and social transformation is needed to address these challenges.

Intensive climate warming is observed throughout the territory of Uzbekistan, over the past decade, the average warming rate was 0.29 ° C. Indicators of climate change in Uzbekistan are an increase in the duration of the dry hot period, an increase in the number of days with heavy precipitation and their high variability, a decrease in snow reserves in mountains and the degradation of glaciation, an increase in the frequency of extreme events, an increase in mudflow hazard, an increase in the frequency of droughts and extreme low water.

These consequences of climate change pose a danger both to the world economy and to the life of people in general, and to the regions of the planet, endangering the well-being of future generations. As a result, the idea of transition to sustainable development arose, which could adapt the world economy to climate change and ensure further prosperity.

It is possible to stop the onset of the irreversible consequences of climate change through a transformation in the economy and in the behavioral habits of people. For example, better use of resources and consumption can reduce negative climate impacts. The transition to responsible production and consumption will allow the exploitation of resources in the longer term, preserving the resource base for future generations. This transition, which will ensure the functioning of the economy without creating the risk of complete depletion of resources for future generations, is considered within the framework of the concept of sustainable development, which began its development in the 70s and 80s of the last century.

On May 9, 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in New York. In June 1992, at the UN Conference on Environment and Development in Rio de Janeiro, [2]it was opened for signature. After the required number of ratifications in March 1994, the UNFCCC entered into force, providing legal support for climate change prevention. Specific commitments were made for developed countries, in particular national policies and measures that would demonstrate their leadership as developed countries in changing long-term trends in anthropogenic emissions, and in 1997 the Kyoto Protocol was signed and ratified by 192 countries by 2005. United Nations Framework Convention.

On September 25, 2015, 193 member states of the United Nations adopted the Final Document of the General Assembly "Transforming Our World: The 2030 Agenda for Sustainable Development" [3]. This document contains 17 global goals in the field of sustainable development and 169 corresponding targets that are comprehensive and indivisible and ensure a balance of all three components of sustainable development: economic, social and environmental.

In November-December 2015, the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) was held in Paris. As a result of the conference, the so-called "Paris Agreement" was adopted [4], which was signed by all 196 parties and the European Union. The agreement aims to strengthen the global response to the threat of climate change (Paris Agreement, Article 2) in the context of sustainable development and efforts to eradicate poverty.

This agreement commits all countries to take steps to keep global temperature rise well below 2° C and, given the severity of the risks involved, to strive to limit temperature rise to 1.5 ° C (current average temperature is 0.75 ° C). C higher than the annual averages in 1850-1900). The Paris Agreement aims to create a decarbonized society.

The agreement consolidates and formalizes the turn to a new, low-carbon model of economic development based on the gradual abandonment of traditional technologies for the extraction, processing and use of fossil resources, primarily hydrocarbons, in favor of "green" technologies. The Paris Agreement provides a road map for measures to reduce emissions and build climate resilience.

[2]https://www.un.org/esa/dsd/resources/res_docukeyconf_eartsumm.shtml

[3]Technical report by the Bureau of the United Nations Statistical Commission (UNSC) on the process of the development of an indicator framework for the goals and targets of the post-2015 development agenda (Working draft)

[4]https://www.un.org/en/climatechange/paris-agreement

The problem of high carbon intensity of the economy is central to many developed and developing countries of the world. The transition to low-carbon development is especially difficult for resource-based economies, however, in times of crisis, the transition to a new model can provide a chance to make a qualitative breakthrough in the development of the economy and, through decarbonization, make it more sustainable in the future.

1.2. Energy transition and reduction of greenhouse gas emissions

At the beginning of the 21st century, the threat of global climate change caused by anthropogenic greenhouse gas (GHG) emissions became apparent [5]. In response, the world community is taking measures to reduce GHG emissions (decarbonization), primarily carbon dioxide, and for the oil and gas industry and the livestock industry, it has also become especially important to reduce methane emissions, which causes a much stronger greenhouse effect than CO_2. Each greenhouse gas (carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and ozone in the lower atmosphere) has a different impact on climate change. The greatest contribution to the processes of global warming is accounted for by carbon dioxide and methane.

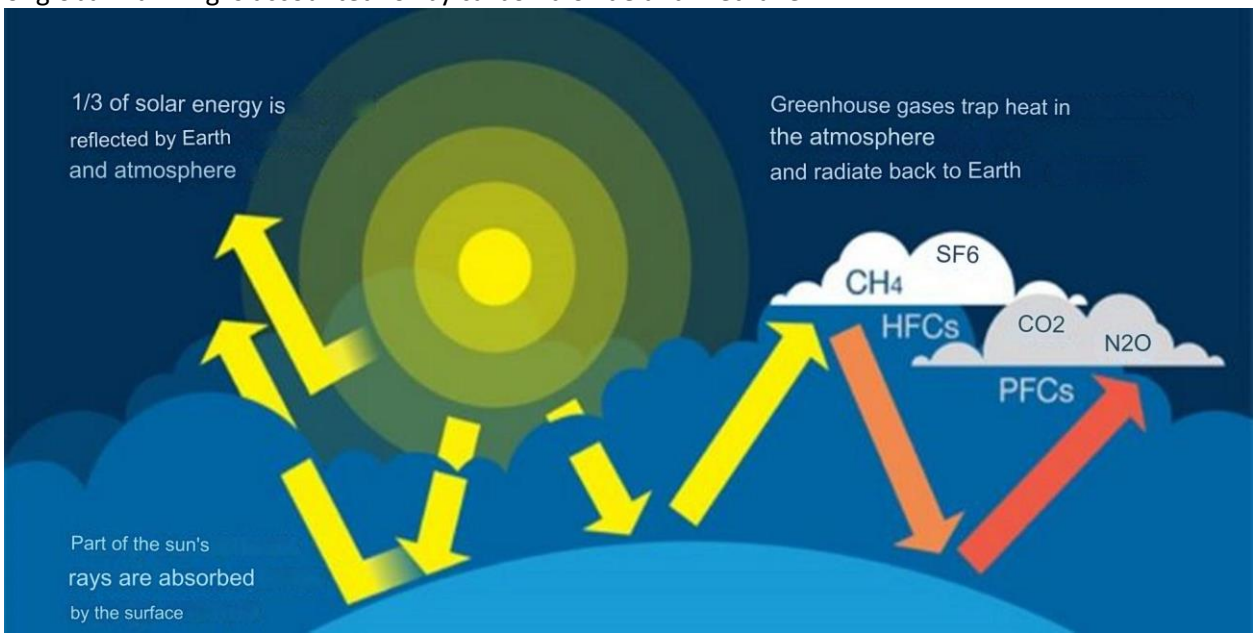


Figure 2. Greenhouse effect

A natural phenomenon that leads to an increase in the concentration of greenhouse gases in the air and an increase in temperature on the surface of the planet is called the greenhouse effect. Because of this, the lower layers in the atmosphere heat up, and, consequently, the ambient temperature rises, violating the permissible norms.

A similar phenomenon resembles an ordinary greenhouse or greenhouse, which retain heat in the garden. The role of the film in this case is played by carbon dioxide, the concentration of which is constantly growing. The change in the heat balance on the planet occurs due to the excess of emissions of certain gases, as a result of their accumulation in the layers of the atmosphere leads to the development of the greenhouse effect. This accumulation is the main reason for this phenomenon.

The constant impact of solar radiation and thermal energy on our planet heats the surface of the Earth to a certain temperature. Some of this heat is reflected and some is absorbed by greenhouse gases, which in turn leads to re-radiation.

Sustainable development without harm to the environment and the atmosphere is possible with the reduction of greenhouse gas emissions, which is characterized by the process of decarbonization of the global economy. Global decarbonization i.e. the global transition to low-carbon development is a

[5] Mitrova T., Khokhlov A., Melnikov Yu. et al. Global climate threat and the Russian economy: in search of a special way. M.: Moscow School of Management SKOLKOVO, 2020. https :// energy . skolkovo . ru / downloads / documents / SEneC / Research / SKOLKOVO _ EneC _ Cli mate _ Primer _ EN . pdf .

response to global climate change caused by anthropogenic emissions of greenhouse gases into the atmosphere.

The contribution of the Republic of Uzbekistan to global emissions is about 0.3% [6]. GHG emissions per capita as a whole amount to 5.8 tons of CO_2-eq/person; including $CO_{2\ emissions}$ – 3.1 t CO_2-eq/person; methane - 2.3 t CO_2-eq / person; nitrous oxide - 0.44 t CO_2 eq / person In the last five years, there has been a decrease in specific GHG emissions per capita, which is due to both an absolute decrease in GHG emissions and a consistently high population growth rate (average 1.6% per year).

At the same time, the Energy sector makes the largest contribution to the total GHG emissions (76.3%). The share of the "Agriculture" sector accounts for 17.8%, the "Industrial processes and use of products" sector - 4.5%, "Waste" - 1.4%.

The following are the five most significant emissions, the contribution of which to the total GHG emissions in the country amounted to about 63% in total:

- fugitive methane emissions from gas systems in the oil and gas industry (22.7%);
- carbon dioxide emissions from fuel combustion in the production of electricity and heat (13.3%);
- carbon dioxide emissions from fuel combustion in industrial sectors and construction (10.0%);
- methane emissions from enteric fermentation of livestock (9.4%);
- carbon dioxide emissions from fuel combustion in the residential sector (8.4%).

The purpose of decarbonization is to reduce these emissions, thereby mitigating (slowing down) climate change and minimizing the damage it causes . Realization of this goal will have the most serious impact on the world economy. The changes will affect the energy sector, transport, construction, industry and agriculture. The requirements for land and forest management will become more stringent. One outcome of the transition to low-carbon development will be a reduction in demand for fossil fuels and an increase in the role of renewable and other green energy sources.

As the analysis shows, global CO_2 emissions mainly come from the energy sector, therefore, the main efforts to reduce anthropogenic GHG emissions are concentrated today in this sector. This is due to the dominant role of energy sources of GHG emissions, as well as the fact that traditional technologies for generating energy based on the combustion of fossil fuels have an understandable and affordable low-carbon alternative - the use of renewable energy. With this in mind, in the Paris Agreement, the countries came to a consensus on starting the process of decarbonization from the stage of transition to renewable energy sources - the energy transition.

Energy research is perhaps more important now than ever. The economy operates on a continuous supply of energy, and while the world is still dependent on non-renewable sources of energy for electricity, heating and transportation, more and more countries are embarking on an energy transition that could change the entire global energy system .

The impetus for the start of the energy transition was the recognition of the threat of climate change as a global problem, with which 195 states and the European Union (hereinafter referred to as the EU) agreed to work together to combat climate change, mainly by reducing anthropogenic greenhouse gas emissions, which are most likely to cause climate change. An analysis of the energy strategies of the developed countries of the world shows that they are aimed at energy saving and energy efficiency, self-sufficiency in energy resources, diversification of the structure of the fuel and energy balance through the development of renewable energy sources, the extraction of unconventional hydrocarbons and the introduction of other alternative technologies.

In recent years, technologies for the practical use of photoelectric power converters have developed most rapidly in recent years, the annual growth of which was about 60%. Other technologies for the use of renewable energy were also introduced at a high pace: wind turbines - 28%, biofuel production - 25%, solar heating installations - 17%, geothermal heat supply - 13%, small and micro hydropower plants - 8%.

[6] https :// hydromet . uz

To ensure that the goals set out under the Paris Agreement are met, each country has specifically defined its climate policy goals for 2030 in the long-term context of forecasting up to 2050. The climate goals declared by the largest developed and developing countries are shown in the Table below.[7]

Table 1. Climate targets set by major developed and developing countries

Countries	Stated provisional goals (contributions) for the period up to 2025 (2030)
	Industrialized countries:
USA	By 2025, reduce GHG emissions by 26-28 % from 2005 levels.
Canada	By 2030, reduce GHG emissions by 30% from 2005 levels
Germany	By 2030, reduce GHG emissions by at least 40%, and if possible by 55%, from 1990 levels.
France	By 2030, reduce GHG emissions by 40% from 1990 levels
Norway	By 2030, reduce GHG emissions by 40% from 1990 levels
Russia	By 2030, reduce GHG emissions to 70-75 % of 1990 emissions, assuming that the absorptive capacity of forests is taken into account as much as possible
	Major developing countries:
Brazil	By 2025, reduce GHG emissions by 37% from 2005 levels
Mexico	By 2030, reduce GHG emissions by 22-36 % from the baseline.
China	By 2030, reduce specific emissions by 1 dollar of GDP by 60-65 % compared to 2005, with a peak in absolute emissions not later than 2030.

Thus, the EU aims to reduce greenhouse gas emissions by 80-95 % by 2050 and at least 40% by 2030 compared to 1990 levels [8]. The target for renewable electricity by 2030 is over 50% in Germany, 40% in France, 45% in all EU countries and in the US - 50% in the states of California and New York respectively. Developing countries, including China and India, are identifying the maximum use of renewable energy sources as the main strategy for making the transition to a low-carbon society. China has set itself the goal of achieving zero emissions by 2060.

Solving this problem is especially important for Uzbekistan in light of the adoption of new energy policies in other countries that aim to significantly increase renewable energy in the national energy mix or, in some cases, to achieve the Net Zero Emissions Target .

2. CURRENT POLICY OF UZBEKISTAN ON DECARBONIZATION IN THE CONTEXT OF ENERGY TRANSITION

The unpreparedness for the global energy transition and the passive nature of supporting the fight against climate change pose a danger to the economy of Uzbekistan, the energy system of which is traditional, which is an obstacle to its development and especially the dynamic penetration of new types of energy.

Uzbekistan joined the United Nations Framework Convention on Climate Change on June 20, 1993, signed the Paris Agreement [9]and on April 19, 2017 made a national contribution to the Secretariat of the United Nations Framework Convention on Climate Change. The Paris Agreement was ratified on November 11, 2018 after the adoption of the Law of the Republic of Uzbekistan No. ZRU-491 dated October 10, 2018 "On the ratification of the Paris Agreement".

[7] http :// downloads . igce . ru / news / Yulkin _ M _ A _ ext _ abstract _ IGCE _06022019. pdf
[8] https :// www . bbc . com / russian / news -50777852
[9] https :// unfccc . int / sites / default / files / resource / FBURUzru . pdf

Decarbonization has become an important political issue in Uzbekistan since the country's ratification of the Paris Agreement. In 2021, Uzbekistan increased its commitment to reduce specific greenhouse gas emissions per unit of GDP by 35% by 2030 from the 2010 base year. [10]Uzbekistan began to develop the necessary documents to achieve the goals of the Paris Agreement and conduct decarbonization.

Uzbekistan has identified numerous measures in support of these goals, including the adoption of the Strategy for the transition to a "green" economy for the period 2019-2030, and the Climate Change Strategy, the Concept for the Development of the Electricity Industry was approved, within which targets for the production of renewable energy in the amount of 5 GW solar and 3 GW wind power by 2026.

The logical continuation of these measures, relevant and expedient, is the development of the Country Development Strategy to achieve the goals of decarbonization of Uzbekistan. This seems to be timely, since the consequences of climate change are becoming more serious for the country every year. By striving for decarbonization, Uzbekistan will be able to actively contribute to industrial, economic and social transformation.

For this, the country has sufficient natural resource potential in the context of renewable energy sources, such as solar, wind, hydro, biofuel energy, the widespread use of which will contribute to the ongoing decarbonization process in the country.

2.1. Overview of the main indicators of energy sector in Uzbekistan

Uzbekistan is located between 64 ° east longitude, 41 ° north latitude. It has no access to the open seas, but includes the southern part of the Aral Sea with a coastline of 420 km. In the northeast it borders with Kazakhstan (2203 km), in the east and southeast with Kyrgyzstan (1099 km) and Tajikistan (1161 km), in the west with Turkmenistan (1621 km), in the extreme south with Afghanistan (137 km). The territory of Uzbekistan, located between the Amudarya and Syrdarya rivers, is a combination of flat and mountainous reliefs. More than 70%, mainly in the northwestern part, are plains, mainly the Turan lowland, within which the Ustyurt plateau and the lower reaches of the Amu Darya stand out in the northwest, and the Kyzylkum desert in the north. Foothills and mountain ranges belonging to the systems of the Western Tien Shan and Gissar -Alay are located in the east and southeast and occupy about 1/3 of the territory.

The longest rivers (km) of the country are the Syrdarya (2122 km), Amudarya (1415 km), Zarafshan (877 km). The largest water reservoir is the Aral Sea - an inland drainless salty reservoir that has both marine and lake features. Since the late 1950s The level of the Aral Sea is rapidly decreasing due to an increase in the water intake of the Amudarya and Syrdarya for agricultural needs. The decrease in the level of the Aral Sea and the desertification of adjacent territories is the largest environmental disaster, the scale of which goes beyond the region.

The Republic of Uzbekistan in terms of its demographic (population is about 35 million people, which makes the country the undisputed and absolute regional leader), economic (second place after Kazakhstan in the region in terms of all macroeconomic indicators) and geopolitical (borders with all other countries of the region and Afghanistan) potential is extremely important state of Central Asia (CA).

The Republic of Uzbekistan is a resource-rich country with a developing economy and a stable annual GDP growth rate of more than 5%. According to the UN forecast, by 2030 the country's population could reach 37 million people. The Uzbek economy, according to official data, has always been characterized by consistently high growth rates: 7.8% (2011) and 5.6% (2019) [11]. In dollar terms, there was a decline to 28% in 2017, which was associated with the reform to liberalize the exchange rate. Uzbekistan during the COVID pandemic has become one of the few countries with a positive overall economic development. At the end of 2020, GDP growth amounted to 1.6%. The driver of the republic's economic growth is the industrial sector, services and construction sectors.

[10] https :// uza . uz / ru / posts / cop 26- vypolnenie - obyazatelstv - i - podderzhka - es - v - klimaticheskom - perexode - uzbekistana _320725

[11] https :// cyberleninka . ru / article / n / toplivno - energeticheskiy - sektor - ekonomiki - uzbekistana - sostoyanie - i - problemy

Nevertheless, nowadays, it is difficult to assess the impact of economic growth on environmental sustainability and the environment, and, as a result, on the quality of human life. Traditional measures of socio-economic activity (such as GDP and per capita income) fail to adequately measure a country's progress in economic development, social progress and environmental goals at the same time.

Uzbekistan is the largest electricity producer in Central Asia, with a total installed capacity of over 12 GW, generating about 63 TWh per year (billion kWh) or 2 MWh per capita.

Figure 3. Operating power plants of Uzbekistan

British Petroleum states natural gas accounted for [12]36.6 million tons of oil equivalent (Mtoe) (83.4%) in the primary energy structure of Uzbekistan . Other sources, such as oil, coal and hydropower, totaled 7.3 Mtoe (5.9%, 7.1% and 3.6% respectively), while hydropower is the only renewable source in the overall structure of primary energy production, the share which is only 3.6% of the total.

At the end of 2021, the installed capacity of the country's power plants increased by 1.2% and amounted to 16 527 MW. According to the "Concept for providing the Republic of Uzbekistan with electric energy for 2020-2030 " [13], by 2030 the installed capacity of all stations will reach 29,200 MW, of which the share of renewable energy (HPP, WPP, FPP) will be 40.4%.

*Generation, production and distribution of electricity***.** Currently, in the structure of electricity generation (the process of producing electrical energy by converting other forms of energy) in Uzbekistan, 85% of all electricity is generated at TPPs running on gas and coal. Hydropower, the dominant renewable source in Uzbekistan's electricity system, generates about 15% of total electricity generation, with other renewable sources accounting for less than 0.1% of consumption. Having a great potential for hydrocarbon raw materials, the possibilities for building new hydroelectric power stations, in contrast to the predominantly mountainous Tajikistan and Kyrgyzstan, are limited in Uzbekistan.

[12] https :// www . rbasia . uz / rynok - energetiki - uzbekistan

[13]https://lex.uz/docs/4539506

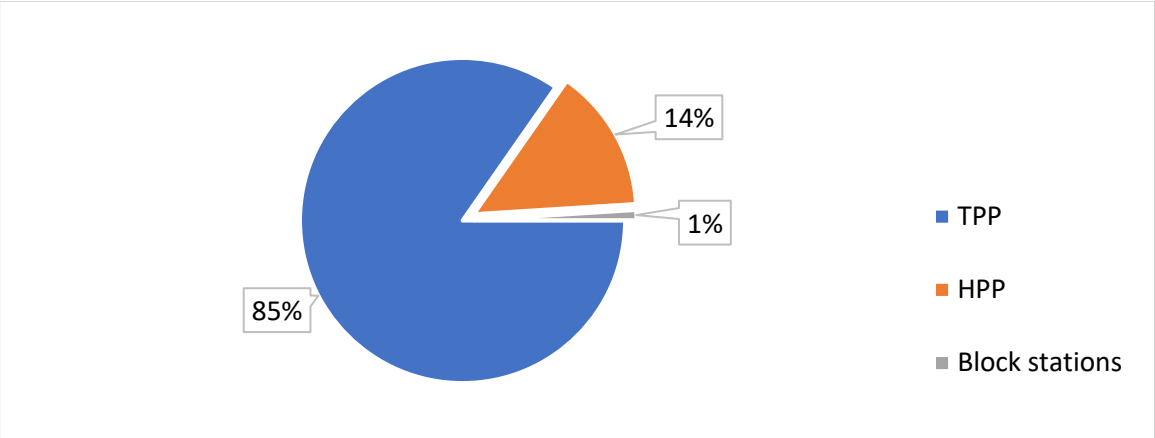


Figure 4. Electricity generation

Uzbekistan manages a significant portion of the installed capacity of the Central Asian interconnected power system and has a well-developed electricity sector covering almost 100% of the population. The country can meet its energy needs from its own primary energy sources, where two state-owned companies, thermal power plants and water power stations in Uzbekistan, provide most of the electricity.

The National Power Grids of Uzbekistan and the Regional Power Grids are responsible for the transmission and distribution of electricity. Also, Uzbekistan has cross-border transmission lines with Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan. This provides opportunities for regional interconnection of energy systems and a common interconnection in accelerating the decarbonization of the region.

The total length of power transmission and distribution networks in the country exceeds 230,000 km . The basis ("framework") of the network economy is made up of power lines with a voltage of 500 kV (1.8 thousand km), 220 kV (6.2 thousand km) and 110 kV (12 thousand km), the vast majority of which were created in the second half of last century (about 30 years back) [14]. They are designed taking into account the peculiarities of the region's integrated energy supply system (Uzbekistan- Kyrgyzstan-Tajikistan-Kazakhstan-Russia), which provides for mutual supplies of fuel and energy products - gas, oil products, coal and electricity.

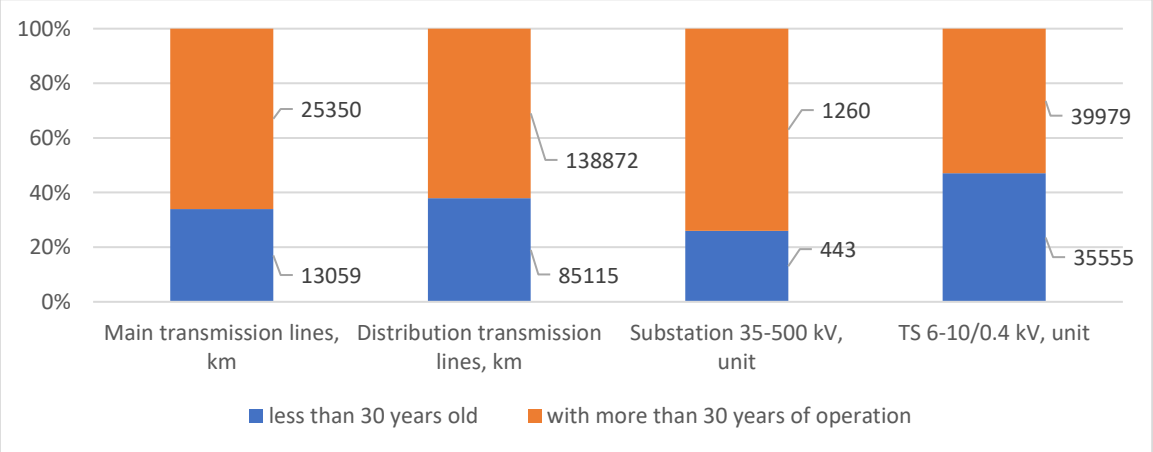


Figure 5. Electric networks of Uzbekistan

The national IPS allows the transmission of electricity to 14 regional dispatch centers, from which it is supplied to end consumers using more than 250 distribution systems. Power distribution tasks are provided by power lines with a voltage of 35 kV (total length - 14 thousand km), 6-10 kV (100 thousand km) and 400 V (105 thousand km).

[14]The concept of providing the Republic of Uzbekistan with electric energy for 2020-2030

In 2013, with funding support from the World Bank and Uzbekenergo JSC, in the south-east of the country, work began on the modernization of the Talimarjan TPP and the construction of a single-circuit transmission line connecting the specified power plant and the Sogdiana substation (VL-500 kV was introduced into operation in 2017), in order to improve the reliability of energy supply to consumers in Navoi, Bukhara, Kashkadarya and Samarkand regions, as well as to expand export opportunities.

Over the past 5 years, almost 4.5 times more power transmission lines have been built and reconstructed in the country than in the period 1991-2016. So, if from 1991 to 2016 9,300 km of power lines were built and reconstructed, then in 2017-2021, about 40,700 km of power lines were built and reconstructed. As a result, power supply has improved for more than 4.2 million households in more than 7.3 thousand mahallas across the country.

To ensure the stability of the energy system in the future, by 2026 it is planned to create a single ring system through the construction of networks with a voltage of 500–750 kV.

The electricity system of the country is usually divided into 5 territorial nodes: northwestern, southwestern, southern, eastern and central. The central system includes stations of Jizzakh, Syrdarya, Tashkent regions and the city of Tashkent.

The network economy and the vast majority of the country's generation facilities (about 97% of the total installed capacity) are controlled by the state. The company responsible for managing the United Energy System, providing the economy and the population with coal and electricity is Uzbekenergo JSC. It manages 10 thermal power plants and 28 hydroelectric power plants. Control functions in the electric power industry are performed by the Uzgosenergonadzor inspectorate, directly subordinate to the Cabinet of Ministers.

Consumption. Structure of electricity consumption by sectors of the economy and population for 2021 the following: industry - 35.9%, population - 27.7%, agriculture -16.6%, utilities - 4%, budgetary organizations - 2.4%, transport - 1.5%, construction - 1% and others - 10.8%.

Figure 6. Volume of electricity production

In the period from 2017 to 2020, electricity consumption increased from 60 to 69 billion kWh, in 2021 the volume of electricity production increased by 6.1% compared to the previous year and reached 70.1 billion kWh.

The sharp increase in electricity consumption is associated with population growth, as well as economic growth. According to the "Concept for providing the Republic of Uzbekistan with electricity for 2020-2030", it is expected that the annual growth in electricity consumption until 2030 will be 6-7%, the volume of energy generation will increase by 72.3% compared to the previous year and will reach 120.8 billion kWh, incl. from RES (HPP, WPP, FES) – 31.6 billion kW/h (26.1%). At the same time, the consumption

of electric energy by sectors of the economy will increase from 42.7 to 85 billion kWh, and consumption by the population - from 15 to 21 billion kWh.

The energy system of Uzbekistan is in short supply, so the country is forced to import electricity from abroad. The lack of electricity in 2021 was compensated by imports from the neighboring countries of the region - Turkmenistan, Tajikistan, Kazakhstan and Kyrgyzstan. It is noteworthy that, thanks to the favorable pricing environment in the electricity supply market, in 2021, when exporting electricity to Afghanistan, the country managed to compensate for about 31.3% of electricity import costs.

2.2. Assessment of the potential for the use of renewable energy

The climatic and natural conditions of the Republic of Uzbekistan provide ample opportunities for the use of renewable energy sources. The basis of the strategic directions for the development of renewable energy in Uzbekistan are hydropower, solar and wind energy, bioenergy and geothermal energy. The total gross potential of alternative energy sources in Uzbekistan is estimated at 50,984.6 million tons of oil equivalent. Technical potential (what can be realized using existing technologies) - 179 million toe. e. This is more than 3 times the amount of fossil fuel produced annually in the country.

Table 2. Types of RES

Name	Gross	Technical	Mastered
Hydropower of large rivers	8	1.81	0.56
Hydropower of small rivers, reservoirs and canals	1.2	0.51	0.16
Solar energy	50973	176.8	0
Wind energy	2.2	0.4	0
Biomass	10.0	3.0	0
Geothermal waters	0.23	0.0	0.0
Total	50984.60	182.52	0.72

Energy of sun. Solar energy is the largest energy source on Earth. The amount of solar energy coming to Earth exceeds the energy of all the world's oil, gas, coal and other energy resources, incl . renewable, and at 20 000 times higher than the current energy consumption of the world economy.

The data indicate that Uzbekistan has a huge solar resource potential. The daily values of the insolation level increase from 3.6 to 4.6 kW/h/m2. The number of cloudless days in the republic averages 250-270 . The data of long-term observations on the network of actinometric stations of Uzbekistan show that the duration of sunshine for different regions of the Republic varies from 2410 to 3090 hours a year, with fluctuations during the day of the seasons, with a duration of 11 hours in summer and 4 hours in winter. There is also a difference in the amount of solar radiation received, which is 27 MJ/m2 per day in summer and about 7 MJ/m2 in winter.

Gross potential of solar energy - 50973 million toe. e., and the technical potentials are approximately 177 million tons. e., covering about 98 percent of the total technical potential of renewable energy sources in Uzbekistan and exceeds the energy potential of all proven hydrocarbon reserves of the country.

The source of solar energy is almost universal - it allows the production of electrical and/or thermal energy. At the geographic latitude of Uzbekistan, the utilization of solar energy is possible through the use of a wide range of industrial technologies: solar batteries (photovoltaic converters), concentrators of various types, combined stations and used to generate electricity (centralized and decentralized), produce thermal energy and motor fuel.

The technical potential of solar radiation energy for photovoltaic converters with different efficiencies using 1% of the territory of the regions of the republic is given in Table 2.

Table 3. Technical potential of solar radiation energy for photovoltaic converters with different efficiencies when using 1% of the territory of the regions of the republic

Region name	Square	SU without tracking the Sun

No.		thousand km ^{2}	14%		18%	
			W_T Power generation	Volume of natural gas to be replaced	W_T Power generation	Volume of natural gas to be replaced
			Billion kWh/year	Billion m ^{3} / year	Billion kWh/year	Billion m ^{3} / year
1	Karakalpakstan	164.9	175	57.75	224	73.92
2	Andijan	4.2	0.25	0.08	0.33	0.11
3	Bukhara	39.4	32	10.56	41	13.53
4	Jizzakh	20.5	eleven	3.63	17.5	5.78
5	Kashkadarya	28.4	19.6	6.47	25	8.25
6	Navoi	110.8	84	27.72	105	34.65
7	Namangan	7.9	0.47	0.16	0.6	0.20
8	Samarkand	16.4	12	3.96	15	4.95
9	Surkhandarya	20.8	17	5.61	36	11.88
10	Syrdarya	5.1	1.5	0.50	2	0.66
eleven	Tashkent	15.6	6.9	2.28	9.1	3.00
12	Ferghana	7.1	0.41	0.14	5.3	1.75
13	Khorezm	6.3	2.9	0.96	3.8	1.25
	Total for Uzbekistan	447.4	363.03	119.80	484.63	159.93

Small waterpower stations. An efficient, reliable, inexhaustible source of energy is the movement of water flow. Hydropower is the most developed form of renewable energy. One tenth of the economic potential is made up of small and micro HPPs (SHP plants and plants with a capacity of up to 30 MW). A small hydroelectric power plant is a hydroelectric power plant that produces a relatively small amount of energy. The classification of this type of HPP is determined by such a parameter as power. These power plants are safer than nuclear ones, more productive than windmills or solar panels and have the highest efficiency.

The gross potential of hydropower in the republic is 9.2 million tons, of which small rivers, reservoirs and canals - 1.2 million toe. e. The technical potential equal to almost 2 million toe has been developed in Uzbekistan by 35 percent.

Waterpower generation in Uzbekistan began its rapid development as one of the first among renewable energy sources. From the beginning of the 20th century to the present day, this industry has been a backbone for the entire complex with a total generation of 10–15% of energy. Over the past 20 years, it reached its maximum production in 2010. In recent years, a large-scale program for the construction of hundreds of small and micro power plants has been implemented , according to forecasts, the figures should increase from year to year and by 2030 become more than twice as high.

For settlements located along the valleys of small rivers and watercourses, it is advisable to use small HPPs for decentralized power supply of settlements located in close proximity to consumers in order to avoid the construction of expensive power lines and step-down transformer substations. In combination with other alternative energy sources, they can become more efficient sources of energy supply. SHPPs can also be built on existing irrigation facilities - fast currents, drops, etc. This will make it possible, among other things, to use ready-made structures for SHPPs and reduce the cost of their construction.

Wind power stations. Due to the geographical position of Uzbekistan and the complex climatic processes caused by the surface layer of the atmosphere, wind energy in the republic has a seasonal nature. Conducted studies in the local desert, foothill and mountainous areas of the country have shown that the average wind speed in these areas is in the range from 5 to 20 m/sec. The specific power of the wind flow on average in the republic is 84.0 W/m2 and varies from 20.0 W/m2 in Andijan to 104.0 W/m2 in Navoi region. The distribution over the territory of the total duration of energy-active (3 m/s and more) wind speeds is similar to the distribution of average speeds. The maximum duration (6-8 thousand hours

per year) is typical for the coasts and the ridge zone of mountain ranges. In desert areas, such speeds are observed for 3-4 thousand hours, in the Ferghana Valley about 1500 hours.

long -term meteorological observations (more than 10 years) of wind speed at 88 meteorological stations in Uzbekistan, is 2.22 million toe per year. The technical potential of wind energy in the republic is estimated at 0.43 million tons in a year.

As is known, for wind power plants to generate electricity, the minimum required wind speed should be in the range of 3-4 m/s. As shown on the wind map of Uzbekistan, the wind speed in the regions of the republic increases from 3.3 m/s to 24.4 m/s, which makes it possible to use the potential of the regions for the localization of wind power plants.

The most characteristic areas of the regions and the Republic of Karakalpakstan with the presence of zones with wind resources at a height of up to 10 m above the Earth's surface are shown in the table below

Table 4. Zones with wind resources

Name	characteristic areas
Republic of Karakalpakstan	Ustyurt plateau
Andijan region	Khonabad , Khuzhaobod , Ulugnor districts
Fergana region	Shakhimardan, western region of Kokand
Namangan region	western region of Kokand
Surkhandarya region	Baysun, Sherabad districts
Kashkadarya region	Dekhkanabad region
Samarkand region	districts Daud, Urgut
Jizzakh region	Zomin districts, Gallaaral
Syrdarya region	Yangiyer district
Tashkent region	Bekabad district, Angren valley, Pskom-Chirchik valley
Navoi region	Zarafshan district
Bukhara region	districts of Kogon , Muborak
Khorezm region	Khazarasp region (Tuprokkala desert)

Biogas technologies. One of the most common energy sources is biomass, which is used in bioenergy and, according to the World Energy Council, will be one of the most important renewable energy sources in the 21st century. The technology of anaerobic digestion of organic materials is based on the process of gradual decomposition of carbon-containing compounds with the help of anaerobic microorganisms.

Bioenergy is the most promising type of renewable energy in Uzbekistan, which has a huge potential for using agricultural waste (especially animal husbandry), the food industry and urban wastewater treatment plants. There are several following reasons why a biogas plant should be an integral part of any agricultural production:

- reduction of emissions of decay products of biomass, in the form of methane gas, into the earth's atmosphere.

- fast processing of animal waste into highly effective organic fertilizers.

- Obtaining a cheap alternative energy source.

Table 5 below presents the potential for organic waste suitable for annual anaerobic digestion in Uzbekistan.

Table 5. Potential of organic waste suitable for annual anaerobic digestion in Uzbekistan

Waste types	Total volume of basic	Indicators	
		Potential	Technical potential

	waste, thousand tons	Coef . accessibility _	use waste management thousand tons	Methane gas production Million m ^{3}	Obtaining organic fertilizers Million tons
Cattle manure	155 855	0.9	140 270	5015	35.1
Sheep and goat manure	28 762	0.5	14 381	561	3.6
bird droppings	4 891	1	4 891	223	1.2
Sugar factory waste	8 276	1	8 276	447	2.1
Waste of wine and vodka factories	5021	1	5021	506	1.3
Food industry waste	504	1	504	52	0.1
Sedimentary sewage sludge	54 750	1	54 750	66	13.7
Total	**258 059**		**228 093**	**6 869**	**57**

geothermal energy. The gross potential of geothermal energy contained in dry heated rocks at a depth of up to 3 km from the soil surface is huge in Uzbekistan. It is about 67,000 million toe. e. However, the technical potential of the resource is disproportionately small, only 0.3 million toe. e.

When diversifying the country's electric power system, taking into account environmental safety, technical and economic efficiency of the use of renewable energy sources, it is necessary to develop strategic directions for the development of energy use in the regions of Uzbekistan. At the same time, special attention should also be paid to the sufficient availability of renewable energy resources in each specifically selected region, object.

2.3. Analysis of the most important factors and identification of key problems and priorities in the development of the energy sector

Uzbekistan's electricity sector needs a fundamental shift from coal and gas to cleaner energy sources to meet growing energy demand in line with projected GDP and population growth, and to meet targets to reduce the country's greenhouse gas (GHG) emissions by under the Paris Agreement.

The main source of greenhouse gases is the process of burning fuel to produce heat and electricity. In the structure of primary energy resources at TPPs for energy production, gas fuel accounts for 94%, and coal for 5%. Up to a quarter of the electricity generated is used to generate energy itself or is lost in supply chains.

The indicator of specific industry emissions is a key one in the issue of climate change. The higher the specific sectoral carbon intensity , the higher the carbon intensity of the economy, the stronger the negative impact of the economy on the climate with economic growth and vice versa.

If we turn to the statistics on emissions of harmful substances into the atmosphere, then after 2017 there is an upward trend. So, if in 2017 853 thousand tons were thrown into the atmosphere, then in 2019 already 952 thousand tons. The main contribution to greenhouse gas emissions into the atmosphere is made by the energy sector (76%), as well as agriculture (17.8%).[15]

In this regard, diversification of available sources of electricity generation is becoming increasingly important, which will be critical to ensure the sustainability of the energy system, which is best achieved by increasing the share of renewable energy sources, expanding regional electricity trade and promoting energy efficiency.

The large-scale use of RES in Uzbekistan (especially in rural areas and mountainous regions) will help improve the energy supply of the population, reduce poverty in the country, create conditions for human development through access to normally functioning sectors of the economy, housing and communal services, and environmental conservation. Also, at the same time it will contribute to the development of new modern technologies, the creation of high-tech production in the country.

[15]https://hydromet.uz

Uzbekistan has adopted a gas saving program . A decrease in natural gas production with the current balance of production and consumption directly means a decrease in electricity production and a failure of the power supply system in the country, since, as mentioned above, at present, the main part of the generating capacity (about 85%) is thermal power plants. In winter, the Ministry of Energy of the Republic of Uzbekistan has to disconnect secondary consumers from natural gas consumption. These secondary consumers are small and medium-sized businesses (SMEs), as well as households and plants for liquefying gas and selling liquefied gas to the population.

The electricity generation infrastructure is aging and inefficient, and is built almost exclusively on natural gas. The service life of a significant part of the electric grid facilities has exceeded 30 years, incl . main networks - 66%, distribution networks - 62%, substations - 74%, transformer points - 50%. As a result, the average level of technological energy losses in the main networks reaches 2.72%, and in distribution networks 12.5%. Therefore, the tasks of increasing energy saving are important as an effective, less capital-intensive and quickly feasible way to solve energy problems. At the same time, the existing lack of control capacities leads to additional daily restarts of TPP power units, respectively, to excessive fuel consumption and additional wear of process equipment.

The energy market in Uzbekistan has traditionally been a fully government-controlled area. Until recent years, almost all enterprises related to the production, transportation and distribution of energy were on the balance sheet of the state. And in order for these enterprises to be attractive to investors, it is necessary to abandon state control and establish market mechanisms for regulating electricity prices. This was stated, in particular, by the President of Uzbekistan at the 20th plenary session of the Senate of the Oliy Majlis on June 21, 2019.

The time is ripe for reforms of subsidies and the carbon pricing mechanism, leveling the playing field by deregulation and creating institutional preferences for carbon-intensive sources, and ultimately the carbon pricing mechanism. The issue of defining a new tariff policy in the context of decarbonization, distribution of regulatory powers between various authorities, including their transfer in the electricity sector to an independent Electricity Market Regulatory Authority, is topical.

In Uzbekistan, starting from 2019, the annual demand for electricity began to exceed supply by an average of 3%, in connection with which there was a steady shortage of electricity, which currently stands at about 66 billion kWh per year. Under the current conditions of energy consumption, accelerated industrialization and population growth in Uzbekistan (and according to UN forecasts, by 2030 the country's population will increase to 37 million people) can significantly increase the economy's need for energy resources and narrow the possibilities of their use as raw materials. First of all, we are talking about hydrocarbon resources, which are limited. According to calculations, if current trends and volumes of resource consumption continue, by 2030 the shortage of energy resources may amount to 65.4% of the total demand.

The energy strategy of Uzbekistan aims to implement the following key objectives, which should help Uzbekistan strengthen its energy sector, reduce dependence on imported energy and improve the energy efficiency of the economy:

- Construction of new energy efficient power plants, including those based on renewable energy sources such as solar, wind and hydropower.
- Reconstruction and modernization of existing power plants, aimed at increasing their capacity and increasing efficiency.
- Development of transport and logistics infrastructure, including the construction of new highways and railways, improvement of roads, as well as the development of seaports and airports.
- Strengthening energy security, including through the diversification of energy sources, the development of domestic energy production and the establishment of partnerships with other countries in the energy sector.
- Implementation of modern technologies and innovations in the energy sector, such as digitalization and automation of production processes, the use of energy management systems, etc.

The energy sector of Uzbekistan continues the stages of reform and at the same time the modernization and expansion of generating capacities. The purpose of this work is to transfer the industry to market relations, upgrade infrastructure, and ensure the growing demand for energy resources of the country's consumers.

The country's leadership has set the task for the Ministry of Energy to double electricity generation by 2030 and reach 120.8 billion kWh (the figure for 2020 is 66.4 billion kWh) [16].

In general, by 2030 it is planned to increase the installed generating capacity (taking into account the decommissioning of physically obsolete equipment by 5.9 GW) to 29.2 GW, or by 16.4 GW (including 4.4 GW of regulatory capacity to cover peak loads) . At the same time, from renewable energy sources it will be 11.8 GW.

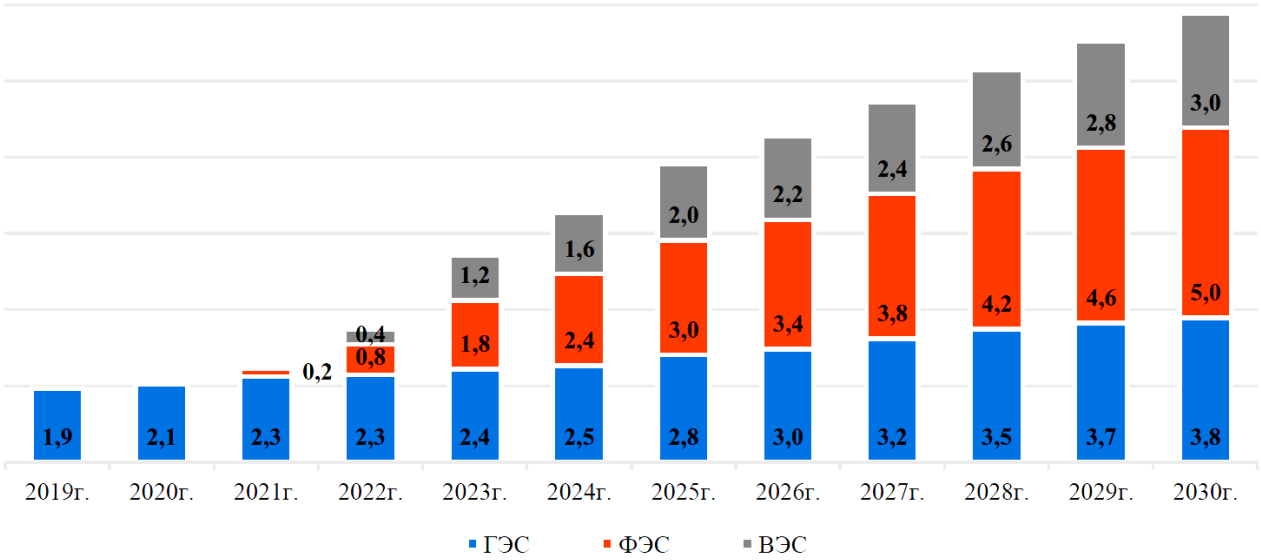


Figure 7. Increase in installed generating capacity from RES

HPP
PV
Wind

Of this volume, thermal power plants using natural gas will account for 13.4 GW (45%), coal - 1.7 GW (5.9%), hydroelectric power plants - 3.8 GW (13.1%), wind power plants - 3 GW (10.4%), photo power plants - 5 GW (17.3%), including 1 GW with energy storage devices, nuclear power plants - 2.4 GW (8.3%). Electricity generation volumes are expected to reach the following indicators:

TPPs — 70.7 billion kWh (58.5%);

HPPs — 13.1 billion kWh (10.8%);

FES — 9.9 billion kW/h (8.2%);

WPP — 8.6 billion kWh (7.1%);

NPPs — 18 billion kW/h (14.9%);

block stations — 0.6 billion kWh (0.5%).

One of the main assets that improves the energy balance of the Republic of Uzbekistan is the future nuclear power plant, which will account for about 8–10% of the country's total energy balance. The launch of the nuclear power plant will save 3.7 billion cubic meters of natural gas, the annual cost of export deliveries of which at current prices is estimated at 550–600 million dollars.

[16]The concept of providing the Republic of Uzbekistan with electric energy for 2020-2030

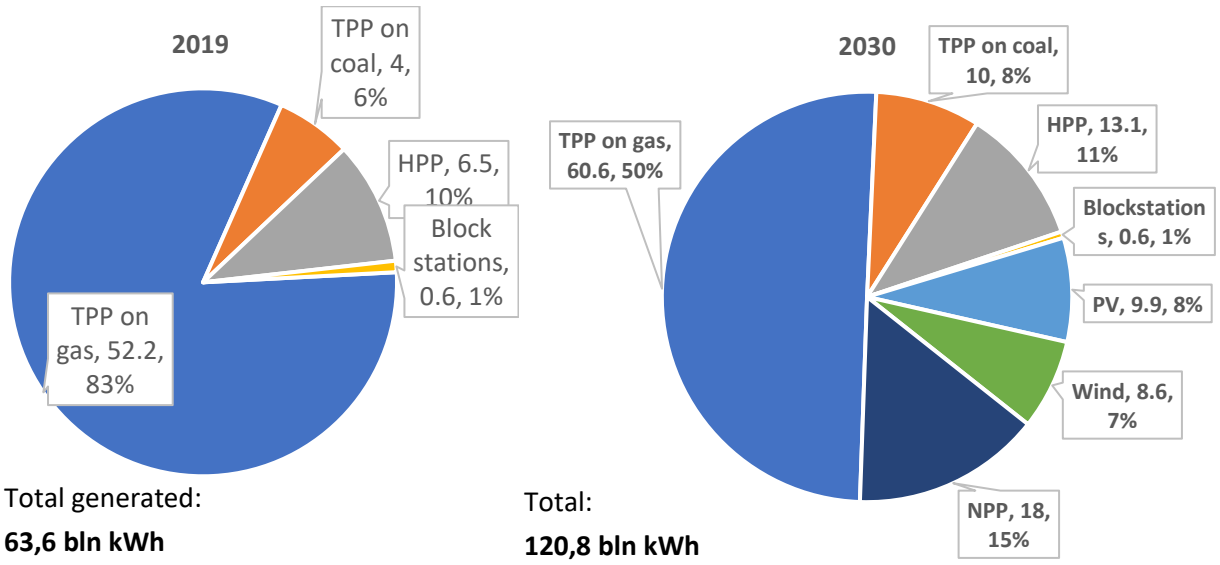


Figure 8. Diagram of changes in generated electricity in 2019 and 2030, billion kWh

The consumption of natural gas for energy generation should be reduced from 16.5 to 12.1 billion cubic meters, fuel oil - from more than 200 thousand to 50 thousand tons, while the annual volume of coal combustion will increase from 4.1 to 8.5 million tons.

The target parameters for the further development of renewable energy are planned to increase the share of renewable energy sources in electricity production from 10-12 % in 2018 to 20% by 2025, including hydroelectric power plants - from 10-12% to 15.8%, solar energy - by 2.3% and wind energy - by 1.6%.

If the plans are implemented, then the structure of electricity generation in Uzbekistan will change by 2030, the share of electricity generation at thermal power plants will decrease from 85% in 2019 to 58% in 2030, new energy sources will appear in the form of photovoltaic power plants (PVP), wind power plants (WPP), nuclear power plants (NPP).

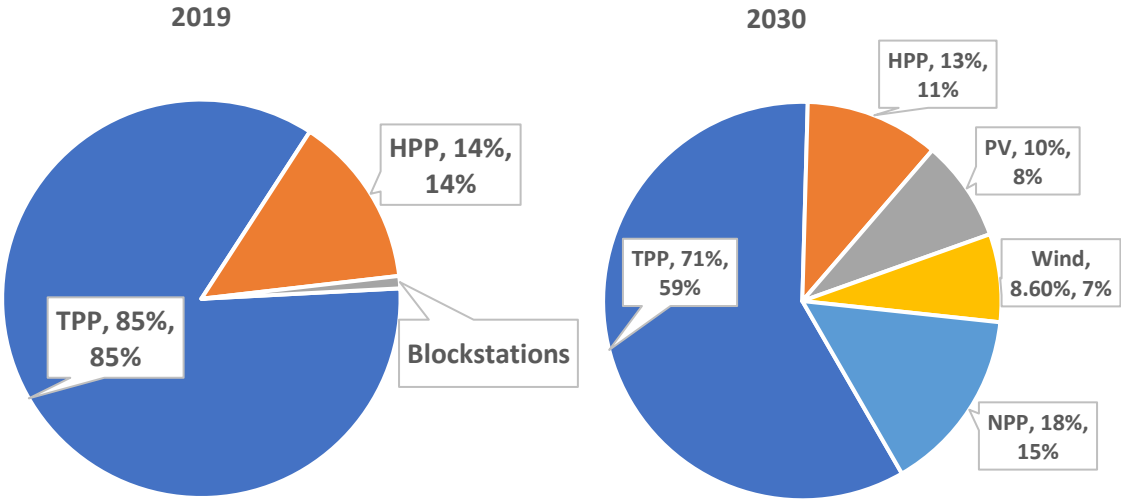


Figure 9. Structure of electricity generation in Uzbekistan in 2019 and 2030

The generating capacity, taking into account the decommissioning of obsolete equipment, will amount to 29.2 GW, the volume of electricity generation will increase to 120.8 billion kW / h, most of the generation will be concentrated in the private sector - hydroelectric power plants, nuclear power plants and part of thermal power plants will remain in state ownership. By 2025, electricity losses during its

transmission will be reduced to 2.4%, or 1.03 times compared to 2019, and during distribution - up to 7.9%, or 1.51 times. By 2030, the loss rate will be 2.35% (1.05 times) and 6.5% (1.85 times), respectively.

In the direction of RES development, the tasks of providing affordable energy in energy-deficient regions of Uzbekistan, improving the environment and increasing energy efficiency, as well as stimulating the development of local industry and infrastructure will continue to be addressed, additional jobs will be created.

At the same time, renewable energy sources can be used in various sectors of the economy.

Table 6. Directions for the use of renewable energy[17]

Type of energy/Indicator	Main directions of use				
	Generation	Hot water/steam	motor fuel	Industrial processing	Universality (number of positive responses)
hydropower	Yes	No	Yes	No	2
Biomass energy	Yes	Yes	Yes	Yes, in selected sectors	3-4
solar energy	Yes	Yes	No/yes for electric vehicles	No	2-3
wind energy	Yes	No	No	No	1
Earth heat energy	Yes	Yes	No	No	2
Hydrogen production	Yes	No	Yes		2

2.4. Assessing the reduction of greenhouse gas emissions through the implementation of targets for the energy sector

In 2021, the first biennial report on updated data of the Republic of Uzbekistan was released[18]. This report has been prepared in accordance with the United Nations Framework Convention on Climate Change. It presents an "ambitious scenario" for the planned measures that should reduce emissions. The document suggested the following:

- 6 projects for the construction of new thermal power plants (3.8 GW), 6 projects for the expansion of existing thermal power plants with an increase in capacity by 4.1 GW. This measure will save 4.1 billion m^3 of natural gas and fuel oil. Emission reduction is estimated at 8.5 million tons of CO_2 equivalent per year.
- Construction of 35 HPPs with a total capacity of 1.53 GW and modernization of 27 existing ones with an increase in capacity by 0.186 GW. Additional electricity generation is estimated at 6.6 billion kWh per year. The contribution to the reduction of emissions will be 1.9 million tons of CO_2 equivalent per year.
- Construction of solar photovoltaic stations with a total capacity of 5 GW with a generation of 6.6 billion kWh per year. Emission reduction will amount to 5.2 million tons of CO_2 equivalent per year.
- Construction of wind power plants with a total capacity of 3 GW and a generation of 8.6 billion kWh per year. Emission reduction is estimated at 4.6 million tons of CO_2 equivalent per year.
- The construction of the nuclear power plant will provide an additional 2.4 GW, and the generation will be 18 billion kWh per year. Saving natural gas - 3.7 billion m^3. Reducing emissions - 7.1 million tons of CO_2 equivalent per year.

As a result of the implementation of this plan, in the period from 2020 to 2030, emissions will be reduced by 28.3 million tons of CO_2 equivalent per year. The plan focuses on increasing the capacity of old plants, as well as building new ones that produce lower greenhouse gas emissions.

The balance is expected to shift in favor of renewable energy sources in the near future as the state takes all the necessary measures for this, and more and more investors realize the country's large untapped potential in this area. With the development of renewable energy sources, special attention will

[17] UNDP final report "Prospects for the development of renewable energy in Uzbekistan" (Tashkent, 2007), "Alternative energy sources: opportunities for use in Uzbekistan", (Tashkent, 2011), pp. 74,

[18] https://unfccc.int/sites/default/files/resource/FBURUzru.pdf

be paid to the affordable energy supply of regions with the current shortage of electricity. For the accelerated development of RES, it is planned to widely use public-private partnerships.

Uzbekistan can achieve zero carbon energy as early as 2050, both technically and economically. Investment needs are estimated to be less than 2% of annual GDP for the period 2030-2050. In addition, Uzbekistan can preserve domestic gas reserves, as well as potentially use excess renewable energy production to support the development of a hydrogen economy.

The government is already planning to stop all gas exports by 2025, as it believes it can reap greater economic benefits, create jobs and attract investment by converting gas into more valuable products.

During COP26 in Glasgow, Uzbekistan announced a goal to reduce specific greenhouse gas emissions per unit of GDP by 35% by 2030. By 2026, the goal is to increase the total capacity of solar and wind power plants in the country to 8 GW. To achieve these goals, the Government has taken a number of measures, including the modernization of industrial equipment and buildings, the reduction of fuel consumption in the production of electricity, the issuance of subsidies for the introduction of a wide range of energy-saving technologies.

Projected investments in the energy sector of Uzbekistan to achieve carbon neutrality average $3.65 billion per year in 2020-2030, $2.28 billion per year in 2030-2040 and $3.48 billion per year in 2040-2050 years.

Development of RES power generation. In the period 2020-2030, special attention will be paid to the development of generation based on renewable energy sources, especially solar energy. These projects will be carried out exclusively at the expense of investors - independent producers of electrical energy.

In order to implement the tasks identified in the Development Strategy of New Uzbekistan for 2022-2026, improve the efficiency of measures taken to ensure "green" and inclusive economic growth as part of the Strategy for the transition of the Republic of Uzbekistan to a "green" economy, as well as further expand the use of renewable energy sources and resource conservation in all sectors of the economy, the Program for the transition to a "green" economy and ensuring "green" growth in the Republic of Uzbekistan until 2030 was approved, designed to achieve a reduction in specific greenhouse gas emissions per unit of gross domestic product by 35 percent from the level of 2010.

As part of the Strategy for the transition of the Republic of Uzbekistan to a "green" economy, it is planned to increase the production capacity of renewable energy sources to 15 GW and bring their share in the total volume of electricity production to more than 30 percent, as well as reduce the energy intensity per unit of gross domestic product by 30 percent, including by expanding the use of renewable energy sources.

To achieve the development indicators of renewable energy, the target parameters of the annually commissioned capacities of renewable energy facilities in 2020-2030 have been determined, which provide for the construction of 3 GW of wind and 5 GW of solar power plants.

In wind energy, the main direction will be the creation of large wind farms, with a unit capacity of 100-500 MW, most of which will be concentrated in the North-West region (Republic of Karakalpakstan and Navoi region).

Solar PPPs with a capacity of 100-500 MW will be concentrated mainly in the Central and Southern regions (Jizzakh, Samarkand, Bukhara, Kashkadarya and Surkhandarya regions). However, solar photovoltaic power plants with a capacity of 50-200 MW will also be built in other regions of Uzbekistan. At the same time, large solar power plants (more than 300 MW in total) will gradually be equipped with industrial energy storage systems to ensure the stabilization of intermittent generation and regulation of peak loads.

In order to enhance the attraction of foreign direct investment in the renewable energy of the republic, during 2020-2022. jointly with international financial institutions, competitive bidding (tenders and auctions) was held to determine investors according to the “Build-own-operate” model, with whom long-term (up to 25 years) Agreements for the purchase of electricity will be concluded.

Thus, with the technical assistance of international financial institutions (Asian Development Bank, World Bank Group, European Bank for Reconstruction and Development), competitive bidding was held for the construction of solar power plants in Jizzakh, Samarkand and Surkhandarya regions with a total

capacity of 600 MW and tenders were announced for the construction of another 800 MW of solar PES in other regions of the republic, as well as for the construction of wind farms.

Attention will also be paid to the creation of isolated (not connected to a single electric power system) low-capacity solar photovoltaic power plants in remote settlements of the republic, as well as in regions where ecotourism is planned to develop.

In addition, the construction of solar photovoltaic power plants of medium power (1-20 MW) will be developed for the production of electrical energy for the own needs of industrial enterprises and industrial parks.

Taking into account the rapid growth in the ability of consumers to generate electricity for their own needs and supply its surplus volume to a single electric power system, as well as in order to stimulate the activation of the intra-republican investment potential, a target program was approved to install about 150,000 solar photovoltaic power plants (with a capacity of 2-3 kW) and water heaters (average 200 liters) in 2-2.5% of households in 2021-2025. Taking into account the installation of renewable energy facilities by the population, by 2026 it is envisaged to cover the consumption of 4.3% of households in the republic in the amount of about 800 million kW / h per year through the introduction of partially isolated renewable energy facilities.

2.5. Justification of the need to expand small-scale energy based on the use of renewable energy sources

Small-scale power generation, based on the use of renewable energy sources, is currently the main direction in the development of energy worldwide, plays a significant role in improving the reliability and quality of electricity supplied. Small-scale generation based on RES makes it possible to solve many problems, taking into account the difficulties that exist in traditional energy, in particular, power supply systems for remote consumers.

With traditional energy supply, there are many organizational, financial and technical difficulties, and small generation offers solutions that are extremely flexible and fast in terms of increasing capacity. Reasonable and competent linking of small-scale energy and traditional sources of generation will strengthen certain positions of energy security areas by increasing the stability and viability of the power supply system. Using the approach to the emergence of additional energy sources operating on the basis of local renewable energy resources, in the future, can provide a positive general economic effect, and subsequently increase the competitiveness of the economy in the regions of implementation.

Electricity generation can be carried out in two ways: centralized and decentralized. Centralized generation is large power plants that serve vast territories (regions, districts), decentralized generation is small stations that serve an individual consumer (a separate household, enterprise). It is also customary to divide electricity generation according to the volume of energy generated: large energy (generation of hundreds and thousands of megawatts), small energy (energy generation up to tens of megawatts), mini energy (up to 1,000 kW) and micro energy (up to 50 kW).

Technologies of small, mini and micro generation belong to the field of decentralized energy, namely, to the field of distributed energy. In fact, this is a technology for creating small power plants at the level of a household, a small business, hard-to-reach villages that are impossible or difficult to connect to a centralized network. This makes it possible to ensure a stable and uninterrupted supply of electricity to local facilities and solve a number of problems, both for the end consumer and for the energy sector as a whole. In addition, small, mini- and micro power plants using renewable energy sources can reduce electricity transmission losses (in Uzbekistan - up to 18%), which are present in distribution networks in centralized power supply, and electricity costs, as well as save the environment.

Small and medium enterprises (SMEs) in developed and developing countries occupy from 60 to 80% of national economies. In this regard, the national and world volumes of the energy market can be determined by the energy needs of these types of businesses, and, first of all, by the size range of small power generating systems and installations.

In accordance with the criteria of the International Council for Large High Voltage Electrical Systems (Conseil International des Grands Réseaux Électriques) - the group of small generation includes stations

whose power does not exceed 30 MW, and units of unit power not more than 10 MW[19]. The power of such sources is selected based on the expected power of the consumer, taking into account the existing restrictions (technological, legal, environmental, etc.) and can vary widely (from two to three to hundreds of kilowatts). As a rule, such stations come in three subclasses:

- Micro power plants - power not more than 100 kW
- Mini power plants - capacity 100 kW-1 MW
- Small power plants - power more than 1 MW.

Small-scale energy facilities are very diverse, and for Uzbekistan the following types can be distinguished: solar power plants, wind power plants, small hydropower, electrical installations using biomass energy and gas piston power plants.

A large number of energy technologies that are used in small-scale energy are based on the use of renewable energy sources. Small-scale generation, based on the processing of biomass into electricity and heat, has received the greatest application in the practice of the states of the European Union and the United States. Another particularly rapidly developing small-scale generation technology based on RES is the use of wind kinetic energy to generate electricity. No less promising is the use of solar energy for the production of electricity and heat, and small hydropower has also become widespread.

As world practice shows, a significant demand for products of the renewable energy industry can be provided by small energy producers - owners of individual houses in the residential sector, government and non-profit organizations, as well as non-energy-intensive commercial enterprises and organizations. However, the cost of energy generated by such small producers, and, consequently, the demand potential, significantly depend on the possibilities of connecting small power plants to the common grid. Power facilities connected to the public grid can operate without expensive energy storage systems, sell surplus generated electricity to other consumers, so the payback period for such systems is several times shorter than the payback period for autonomous power supply systems.

Microgeneration based on RES has been developing in the world for about three decades. Navigant Research predicts the commissioning of a larger amount of distributed generating capacity than centralized generation, and by 2026, a three-fold gap between new commissionings of these types of generation is expected in the world [20].

According to the IEA, since 2010, microgeneration has been adding 6 GW of new generation per year, and the leaders in this direction are the European Union, the United States, Japan and Australia. In the not so sunny UK, there are about 1 million houses equipped with solar photovoltaic panels with an installed capacity of less than 10 kW. In Germany, the number of such installations has already exceeded 1 million, in the USA there are about 1.5 million "solar" roofs, and in Australia - 2 million installations.

[19]https://studfile.net/preview/6878223/page:3/

[20]https://www.forbes.ru/biznes/351485-internet-energy-kak-raspredelennaya-energetika-povliyaet-na-bezopasnost-ceny-na

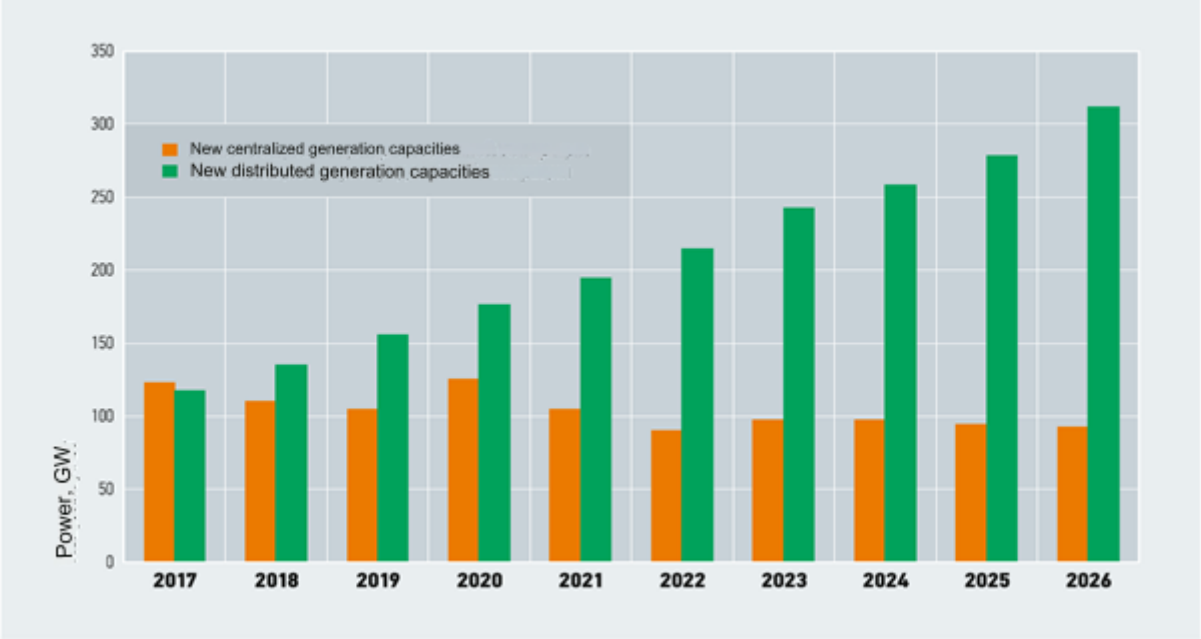


Figure 10. Forecast of the volume of centralized and distributed generation of electricity in the world

From 2010 to 2016, households on average installed about 1 million rooftop solar panels, by 2030 it is expected to be 2 million, and by 2040 - 3 million per year. By 2026, the installed capacity of distributed solar installations combined with energy storage systems, according to Navigant, will reach 27.4 GW.

Microgeneration, as well as large-scale generation through renewable energy, has long been supported through special high feed-in tariffs (feed-in tariff). Currently, due to a significant increase in the competitiveness of renewable energy technologies, many countries have canceled "green tariffs" for industrial facilities, but still retain them for small and micro generation. In Uzbekistan, surplus electricity obtained from renewable energy sources is bought from individuals at a price of 1000 soums, at a cost of 295 soums.

In Uzbekistan, small-scale generation based on RES has a huge potential. In addition to 600 thousand SMEs, there are 4,700 thousand dekhkan farms, administrative, social and other facilities. In accordance with the Decree of the President of the Republic of Uzbekistan No. PP-57 dated February 16, 2023 “On measures to accelerate the introduction of renewable energy sources and energy-saving technologies in 2023”, the country plans to introduce 47,932 small photovoltaic stations in 2023 with an installed capacity of 1,480, 2 MW.

In order to widely introduce renewable energy sources in the social sphere, housing and communal services and sectors of the economy, in accordance with this Decree, in addition to large solar and wind power plants, the commissioning of small power plants at the following facilities is provided:

- objects of the social sphere and public institutions PES 219.4 MW and solar collectors for 455.1 thousand liters.
- buildings and structures of entrepreneurs PES 742.7 MW and construction of small PESs for 555.4 MW
- household facilities PES 182.1 MW and solar collectors for 506.2 thousand liters;
- multi-story buildings PES 15.3 MW;
- creation of small and micro hydroelectric power plants for 196.8 MW.

In total, solar power plants with a total capacity of 1,911.7 MW and solar collectors for 961.3 thousand liters.

3. ASSESSMENT OF THE ACTUAL EFFECTIVENESS OF POLICIES ON THE USE OF RES AND SOCIAL ASPECTS OF DECARBONIZATION IN UZBEKISTAN

3.1. Review and assessment of existing mechanisms of state regulation, normative legal and regulatory acts that affect the change and development of the project goals.

A sufficient legislative framework has been formed in Uzbekistan, covering the sphere of relations in the field of energy, in terms of regulating relations on the use of renewable energy sources and the reduction of GHG emissions.

Energy, in terms of its significance, can be considered as the core and main feature of legal relations in the field of energy. The presence of an element of state regulation characterizes it as an independent public law phenomenon that can be considered using administrative and legal measures.

Public administration, as the basis of relations in the field of energy, denotes the administrative-legal regime for establishing ownership of energy resources. Article 55 of the Constitution of the Republic of Uzbekistan establishes that "land, subsoil, water, flora and fauna and other natural resources are a national property, subject to rational use and protected by the state." In accordance with the norms of the Constitution of the Republic of Uzbekistan, subsoil use and relations related to the circulation of energy resources are formed and based on the following principles:

- the regime of state ownership of subsoil and various forms of ownership of minerals and other resources extracted from the subsoil;
- state regulation regime for the use, disposal and use of useful properties of the subsoil by providing them only for use;
- the mode of payment for the use of subsoil, including the introduction of special fees and charges.

A relevant example is the principle of “state responsibility for the energy security of the country” (Law of the Republic of Uzbekistan “On Electric Power Industry”). This principle imposes additional obligations on the state to ensure the country's sustainable supply of high-quality energy, preventing a shortage of resources, obligations for the efficient use of energy resources, taking into account the interests of the population and increasing the competitiveness of national producers; a commitment to the stable functioning of energy systems by creating strategic reserves of resources, standby capacities and component equipment.

The legislation of Uzbekistan in the field of energy includes a number of laws, decrees and other regulations that regulate the production, transportation, distribution and consumption of energy from renewable sources.

In 2009, the law “On Electric Power Industry” was adopted, which regulates relations in the field of electric power industry. The legislation on electric power industry consists of this Law and other legislative acts.

In 1997, Uzbekistan adopted the Law "On Rational Use of Energy", which establishes the legal framework for the development of green energy in the country and defines measures to reduce energy consumption and increase energy efficiency. In 2020, additions and changes were made to it to meet the new realities.

In 2019, the Law "On the Use of Renewable Energy Sources" was adopted, which defines the legal framework for the production, transportation, distribution and consumption of energy from renewable sources, such as solar, wind, hydropower, etc.

In addition, Uzbekistan has a number of regulations that regulate the production of electricity from renewable sources. For example, the Decree of the President of the Republic of Uzbekistan dated August 22, 2019 No. PP-4422 "On accelerated measures to improve the energy efficiency of economic and social sectors, the introduction of energy-saving technologies and the development of renewable energy sources" defines the rules that must be observed in the production of electricity from renewable sources
.

Uzbekistan also has a Renewable Energy program, which was launched in 2019. The goal of this program is to reduce energy consumption and increase the share of renewable energy sources in the country's total energy balance.

Based on the principle of state responsibility for the energy security of the country and the concept of development of the energy industry of Uzbekistan, more than 40 laws and by-laws have been adopted that determine the functioning of the energy industry and its development.

The list of current legal and regulatory acts that affect the change and development of the project objectives in the energy sector, in the context of the use of renewable energy sources, increasing EE and reducing GHG emissions, includes the following Laws, respectively, by industry of regulation [21]:

1. Law of the Republic of Uzbekistan "On Electricity" (September 2009).
2. Law of the Republic of Uzbekistan "On rational use of energy" (April 1997).
3. Law of the Republic of Uzbekistan "On amendments and additions to the Law of the Republic of Uzbekistan "On the rational use of energy"" (July 2020).
4. Law of the Republic of Uzbekistan "On the safety of hydraulic structures" (August 1999).
5. Law of the Republic of Uzbekistan "On the use of renewable energy sources" (May 2019).

Also adopted a number of resolutions and decrees of the President, resolutions of the Cabinet of Ministers of the Republic of Uzbekistan[22]

1. Decree of the President of the Republic of Uzbekistan dated July 13, 2016 No. PP-2559 “On measures to further improve scientific and technical activities in the field of electric power industry”.
2. Decree of the President of the Republic of Uzbekistan dated May 2, 2017 No. PP-2947 "On the Program of Measures for the Further Development of Hydropower for 2017-2021 ".
3. Decree of the President of the Republic of Uzbekistan dated May 18, 2017 No. UP-5044 "On the formation of the joint-stock company Uzbekhydroenergo".
4. Decree of the President of the Republic of Uzbekistan dated May 18, 2017 No. PP-2972 “On measures to organize the activities of the joint-stock company Uzbekhydroenergo”.
5. Decree of the President of the Republic of Uzbekistan No. PP-3012 of May 26, 2017 "On the Program of Measures for the Further Development of Renewable Energy, Increasing Energy Efficiency in the Economic and Social Spheres for 2017-2021".
6. Decree of the President of the Republic of Uzbekistan dated April 28, 2018 No. PP-3687 “On additional measures for the implementation of investment projects in the field of renewable energy sources”.
7. Decree of the President of the Republic of Uzbekistan dated June 29, 2018 No. PP-3818 “On measures to further streamline foreign economic activity and improve the system of customs and tariff regulation of the Republic of Uzbekistan”.
8. Decree of the President of the Republic of Uzbekistan dated October 23, 2018 No. PP-3981 "On measures to accelerate the development and ensure the financial sustainability of the electric power industry."
9. Decree of the President of the Republic of Uzbekistan dated February 1, 2019 No. UP-5646 “On measures to radically improve the management system of the fuel and energy industry of the Republic of Uzbekistan”.
10. Decree of the President of the Republic of Uzbekistan dated February 1, 2019 No. PP-4142 “On measures to organize the activities of the Ministry of Energy of the Republic of Uzbekistan”.
11. Decree of the President of the Republic of Uzbekistan dated March 27, 2019 No. PP-4249 “On the strategy for further development and reform of the electric power industry of the Republic of Uzbekistan”.

[21] https://lex.uz/ru/

[22] https://lex.uz/ru/

12. Decree of the President of the Republic of Uzbekistan dated August 22, 2019 No. PP-4422 “On accelerated measures to improve the energy efficiency of economic and social sectors, the introduction of energy-saving technologies and the development of renewable energy sources”.
13. Decree of the President of the Republic of Uzbekistan dated June 10, 2020 No. PP-4779 "On additional measures to reduce the dependence of sectors of the economy on fuel and energy products by improving the energy efficiency of the economy and using available resources."
14. Decree of the President of the Republic of Uzbekistan dated July 29, 2020 No. PP-4791 "On measures to further improve the sustainability of electricity supply in the city of Tashkent and the Tashkent region."
15. Decree of the President of the Republic of Uzbekistan dated April 9, 2021 No. PP-5063 “On measures to develop renewable and hydrogen energy in the Republic of Uzbekistan”.
16. Decree of the President of the Republic of Uzbekistan dated December 10, 2021 No. PP-44 “On additional measures for the further development of hydropower”.
17. Decree of the President of the Republic of Uzbekistan dated January 14, 2022 No. PP-88 "On measures to implement the investment project "Construction of a photovoltaic plant in the Nurata district of Navoi region with a capacity of 200 MW"".
18. Decree of the President of the Republic of Uzbekistan dated January 14, 2022 No. PP-87 “On measures to organize the construction of a photovoltaic plant in the Kattakurgan district of the Samarkand region with a capacity of 220 MW”.
19. Decree of the President of the Republic of Uzbekistan dated January 14, 2022 No. PP-86 “On measures to organize the construction of a photovoltaic plant in the Gallaarol district of Jizzakh region with a capacity of 220 MW”.
20. Decree of the President of the Republic of Uzbekistan dated January 14, 2022 No. PP-85 “On measures to organize the construction of a photovoltaic plant in the Sherabad district of the Surkhandarya region with a capacity of 456.6 MW”.
21. Decree of the President of the Republic of Uzbekistan dated September 9, 2022 No. UP-220 "On additional measures to introduce energy-saving technologies and develop low-power renewable energy sources."
22. Decree of the President of the Republic of Uzbekistan dated December 2, 2022 No. PP-436 “On measures to increase the effectiveness of reforms aimed at the transition of the Republic of Uzbekistan to a “green” economy until 2030”.
23. Decree of the President of the Republic of Uzbekistan dated February 13, 2023 No. PP-54 "On measures to improve the efficiency of state control in the field of the use of fuel and energy resources."
24. Decree of the President of the Republic of Uzbekistan dated February 16, 2023 No. PP-57 "On measures to accelerate the introduction of renewable energy sources and energy-saving technologies in 2023".
25. Decree of the President of the Republic of Uzbekistan dated March 30, 2023 No. PP-104 "On measures to further reform the hydropower sector."
26. Decree of the President of the Republic of Uzbekistan dated March 30, 2023 No. PP-106 “On measures to implement the Clean Energy for Buildings in Uzbekistan project with the participation of the World Bank”.
27. Decree of the President of the Republic of Uzbekistan dated May 15, 2023 No. PP-156 “On measures to introduce a system of green energy certificates”.
28. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated August 13, 2015 No. 238 “On approval of the Regulations on the Republican Commission on Energy Efficiency and Development of Renewable Energy Sources”.
29. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated November 16, 2015 N 331 "On the Hydropower Development Program for 2016-2020 ".

30. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated June 22, 2017 No. 407 “On additional measures to organize the activities of JSC Uzbekhydroenergo”.
31. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated August 8, 2017 No. 605 “On amendments and additions, as well as invalidation of certain decisions of the Government of the Republic of Uzbekistan (Decree of the President of the Republic of Uzbekistan dated May 26, 2017 No. PP-3012 “On the Program of measures for further development Renewable Energy, Increasing Energy Efficiency in the Sectors of the Economy and the Social Sphere for 2017-2021”.
32. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated November 22, 2018 No. 949 “On approval of the regulation on state environmental expertise”.
33. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated April 2, 2019 No. 275 "On approval of the feasibility study for the investment project "Construction of the Shaudar small hydroelectric power station on the Dargom canal , construction of a small hydroelectric power station at picket 135 + 50 of the Dargom canal in the Samarkand region"".
34. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated April 2, 2019 No. 276 “On approval of the feasibility study for the investment project “Modernization of the Chirchik HPP Cascade Unitary Enterprise (HPP-10), Samarkand HPP Cascade Unitary Enterprise (HPP-2B), Unitary Enterprise” Cascade of Tashkent HPPs (HPP-1)".
35. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated July 22, 2019 No. 610 “On approval of the Regulations for connecting business entities producing electrical energy, including from renewable energy sources, to the unified electric power system”.
36. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated August 12, 2019 No. 665 "On further measures to ensure the effective use of the republic's hydropower potential through the implementation of promising projects for the construction of microhydroelectric power plants ".
37. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated August 22, 2019 No. 706 "On measures to implement the investment project "Improving the safe operation of the Charvak HPP"".
38. Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated July 23, 2020 No. 452 "On measures for state accounting of devices using renewable energy sources and the energy generated from them."
39. Decree of the Cabinet of Ministers of the Republic of Uzbekistan of November 25, 2020 No. 4899 "On comprehensive measures to develop biotechnologies and improve the country's biological security system."
40. The concept of providing the Republic of Uzbekistan with electric energy for 2020-2030 (2020).
41. Agreement between the Government of the Republic of Kazakhstan, the Government of the Kyrgyz Republic and the Government of the Republic of Uzbekistan on the use of water and energy resources of the Syrdarya river basin (March 1998).
42. Agreement between the Government of the Republic of Kazakhstan, the Government of the Kyrgyz Republic, the Government of the Republic of Tajikistan and the Government of the Republic of Uzbekistan on the parallel operation of the energy systems of the Central Asian states (June 1999).
43. Decree of the President of the Republic of Uzbekistan dated May 31, 2023 No. UP-81 "On measures to transform the sphere of ecology and environmental protection and organize the activities of the authorized state body."
44. Decree of the President of the Republic of Uzbekistan dated May 31, 2023 No. PP-171 “On measures for the effective organization of the activities of the Ministry of Ecology, Environmental Protection and Climate Change”.
45. Decree of the President of the Republic of Uzbekistan dated October 06, 2020 No. PP-4850 “On approval of the concept for the development of the forestry system of the Republic of Uzbekistan until 2030”.

46. Decree of the President of the Republic of Uzbekistan dated October 25, 2019 No. PP-4499 "On measures to expand mechanisms to stimulate the introduction of water-saving technologies in agriculture."

As can be seen from the above regulatory legal acts, a number of policy measures have been adopted that will facilitate the transition of Uzbekistan to low-carbon energy. This is, first of all, the adoption in 2019 of the law "On the use of renewable energy sources", as well as the simultaneous adoption of the National Green Economy Strategy for the period up to 2030.

Such a solid package of adopted normative legal acts shows how much attention is paid to the electric power sector, the development of the use of renewable energy sources. In these acts, a specific “road map” for the development of the energy sector in Uzbekistan emerges.

Especially a lot of regulations have been adopted in the last two years, which was a consequence of the ever-increasing demand for electricity, on one hand, and the realization that the development of the energy sector should not harm the environment, that the future path of energy development is the use of renewable energy sources.

At the same time, it is necessary to further improve the country's legislation on the use of clean energy. Regulatory and institutional reforms are important to enable and support the development of renewable energy sources in Uzbekistan, make both public and private investment in renewable energy attractive to domestic and international investors, and indirectly stimulate the development of the renewable energy production industry.

In this context, there is a need for legal reform to improve the tariff policy and ensure the transition to the wholesale market. The issue of abandoning regulatory and institutional preferences in favor of carbon-intensive sources, abandoning subsidies in the energy sector, in particular, subsidies in the oil and gas sectors, and cross-subsidizing, is topical. It is necessary to create legal conditions in order to equalize the rules for all participants in the energy market. Tariffs should be legislated to reflect costs and the real cost of the product produced, and subsidies should be provided to vulnerable consumers.

There is a need to introduce appropriate legal provisions that encourage investment in the decarbonization of electricity supply. It is necessary to legally regulate the issues of microgeneration, placement and installation of micropower plants , as well as the application of the concept of decentralized energy supply and its legal status, which are not regulated in the country's legislation.

It is necessary to improve legislation on environmental protection, increase the competence and information and analytical potential of statistical departments, apply international methodologies and introduce new reporting standards.

In general, Uzbekistan's green energy legislation is being developed and improved to support the transition to cleaner energy sources and reduce dependence on oil and gas.

3.2. The social aspect of decarbonization in the context of the energy transition

According to the latest World Bank report, Poverty and Shared Prosperity 2020, about 3.3 billion people in the world still live on $5.5 a day, and about 1.8 billion people live on $3.2 a day (in monetary terms at purchasing power parity). The coronavirus pandemic has further contributed to the already slow rate of decline in global poverty, which rose to the 2017 rate of 9.2% (CERR).

According to the World Bank, 736 million people, or about 10% of the world's population, live in extreme poverty (with incomes below $1.9 a day). Due to the effects of the coronavirus pandemic, local conflicts and climate change, an additional 88 million to 115 million people are projected to fall into extreme poverty.

According to the World Bank recommendations, a successful fight against poverty requires a combination of overall economic growth in the country, the creation of additional demand for labor, thoughtful investments in human capital, and social protection for the poor and vulnerable segments of the population.

Central Asia is among the regions that are particularly affected by rising food and energy prices. Uzbekistan is included in the group of countries with a high risk of rising poverty levels due to a sharp increase in prices for basic resources . from the UNDP report.[23]

UNDP, based on data from 159 countries, has calculated the proportion of the population that is at risk of falling into poverty. Three levels of income per person per day were used - $1.9 (absolute poverty according to the World Bank), $3.2 (in lower middle-income countries) and $5.7 (in upper middle income countries). Uzbekistan is among the countries where growth is expected in all poverty groups. This also included Armenia, Pakistan, Sri Lanka in Asia, as well as Ghana, Kenya, Rwanda, Sudan, Burkina Faso in Africa. According to preliminary estimates, the poor population in Uzbekistan is **12-15** percent or **4-5** million people.

The negative consequences of poverty for the socio-economic development of society and the state are manifested in the fact that: **1)** economic growth is held back; **2)** increased social tension in society; **3)** the level of crime rises; **4)** migration processes are activated; **5)** the lifestyle of the population is deteriorating. Poverty can also be considered as one of the negative factors affecting demographic and, consequently, national security.

Vulnerable segments of the population are often even more vulnerable due to the introduction of new technologies, especially if it is associated with access to publicly important services on which the quality of human life depends. These services include electricity. The average electricity consumption per person reflects the level of socio-economic development of the country. The higher this indicator, the more “comfortable” a person lives, the more electrical equipment can be used in production.

Over the past decade, the number of people without access to electricity has almost halved, from 1.1 billion in 2010 to 675 million in 2021, according to a report by the International Energy Agency (IEA), International Renewable Energy Agency (IRE) , the United Nations Statistics Division (UNSD), the World Bank and the World Health Organization (WHO). However, urgent additional efforts and measures are required to ensure that the poorest and hardest-to-reach populations are not left behind. Humanity is still behind schedule to achieve universal access to clean energy for cooking by 2030, the report notes.

Active work is underway in the republic to develop a methodology for defining the concept of poverty, criteria and methods for its assessment. Together with international organizations (UN , World Bank) and leading experts, the Concept and The Poverty Reduction Strategy and the Decree of the President of February 17, 2021 approved the Concept of the National Strategy for Social Protection of the Population for 2021-2030 , which provides for the simplification of the process of obtaining social benefits. *At the same time, the basis for organizing work to provide unified social support and prevent the risk of vulnerable segments of the population falling below the poverty line during the pandemic was the creation of a list of families in need - the " iron **notebook** " daftar ").* into her make 7 categories of families in need of material assistance and support: ***1)*** low-income; ***2)*** families in which there are people with disabilities; ***3)*** families in need of social protection; ***4)*** lonely elderly people; ***5)*** citizens who are permanently unemployed; ***6)*** citizens left without work due to quarantine; ***7)*** people who returned from epidemiologically disadvantaged regions. Thus, according to the Ministry of Economic Development and Poverty Reduction in 2020, **592,586 families** were included in **the list of low-income ones**.

The state provides free secondary education for the population, guarantees a basic package of medical services that includes primary care, emergency care, care for "socially significant and dangerous" conditions and specialized care for population groups classified by the government as vulnerable, provides benefits for low-income families.

The list of low-income families (“Iron Notebook”) , introduced at the initiative of the President, has already yielded great results, becoming the basis for organizing planned systematic work to provide targeted social protection through the following measures:

1) Organization of targeted social support.

2) Ensuring employment of the population.

[23]https://www.spot.uz/ru/2022/07/21/cost-of-living/

3) Development of modern infrastructure.

4) Ensuring the accessibility of education and medicine.

In accordance with the Decree of the President of the Republic of Uzbekistan No. UP-220 dated September 9, 2022 "On additional measures to introduce energy-saving technologies and develop low-power renewable energy sources", the Council of Ministers of the Republic of Karakalpakstan, the khokimiyats of the regions and the city of Tashkent were instructed to ensure the installation of needy families included in "iron notebook", renewable energy equipment (based on one installation unit of a solar photovoltaic power plant with a capacity of up to 1 kW and (or) one unit of a solar water heating device with a volume of at least 100 liters per household) in 2022 - to 20 percent of needy families, in 2023 - 80 percent.

According to experts, the poverty rate in Uzbekistan at the end of 2022 decreased by almost 3% compared to the previous year and amounted to 14%. The study revealed that the greatest reduction in the level of poverty was noted in the Syrdarya, Tashkent, Kashkadarya and Jizzakh regions. At the same time, in Navoi, Surkhandarya and Ferghana regions, there has been no significant improvement in poverty reduction indicators.

Currently, more than 2.3 million needy citizens in the republic receive state social services. The authorities announced a number of measures to improve the situation. The results of similar studies conducted by the Institute for Forecasting and Macroeconomic Research with the support of the United Nations Development Program show that the profile of a low-income household in the republic can be characterized as follows: low-income families are large families with more than 3 children, with a low level of education of family members living in rural areas who do not have an able-bodied migrant abroad who is able to provide assistance .[24]

At the same time, the state of poverty has a pronounced regional specificity, as 8 regions have the highest level of poverty. These include the Republic of Karakalpakstan, Jizzakh, Kashkadarya, Navoi, Namangan, Surkhandarya, Syrdarya and Khorezm regions.

As mentioned above, electricity consumption per person reflects the level of socio-economic development of the country. Uzbekistan has a very low threshold for energy consumption by the population. Based on EIA data *Energy Information Administration*) with an average global annual rate of 3,081 kWh per year, the average electricity consumption per capita in Uzbekistan is 1,465 kWh per year. [25]In terms of average electricity consumption per capita, having an indicator two times lower than the world average, Uzbekistan ranks 128th in the world ranking.

Table 7. List of leading countries by average annual electricity consumption according to EIA[26]

No.	Country	Consumption GWh / year	Population	Year	Average electricity per person, kWh per year
1	Iceland	18.679	361.310	2019	51.699
2	Norway	131.931	5,455,582	2022	24.182
3	Bahrain	27.447	1,641,170	2019	16.724
4	Qatar	43.375	2,832,070	2019	15.316
5	Finland	84.207	5,520,310	2019	15.254
6	Canada	549.263	37,534,000	2019	14.612
7	Kuwait	59.278	4,207,080	2019	14.090
8	Sweden	131.798	10,285,450	2020	13.085

[24] The impact of economic growth on the reduction of the share of low-income population in Uzbekistan. Brochure IPMI and UNDP, 2012

[25]https://unece.org/sites/default/files/2022-01/Report-UNDP_Data-on-energy-consumption_Rakhmanov.pdf

[26] EIA (English) *Energy Information Administration*)

9	United Arab Emirates	119.455	9,770,530	2019	12.226
10	USA	3,989,566	328,200,000	2019	12.154

Among the CIS countries, Uzbekistan occupies the last 15th place in terms of average annual electricity consumption per capita, and among the neighboring countries of Central Asia, the penultimate place. If we assume that the average electricity consumption per person reflects the level of socio-economic development of the country, then according to this indicator, Uzbekistan is two times lower than Iran, and three times inferior to Kazakhstan.

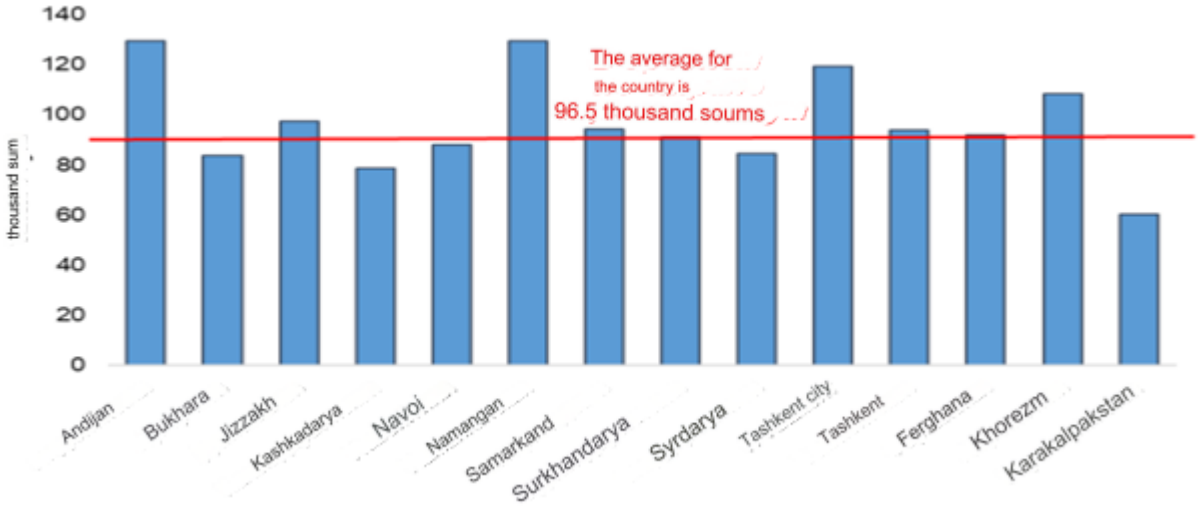
Table 8. List of Central Asian countries by average annual electricity consumption according to EIA

No.	A country	consumption , GWh / year	Population	As of	Average electricity per person , kWh per year
1	Kazakhstan	91.668	18,513,930	2019	4.951
2	Iran	254.724	82,913,910	2019	3.072
3	Turkmenistan	15.090	5,942,090	2019	2,540
4	Kyrgyzstan	11,740	6,456,900	2019	1.818
5	Tajikistan	16.085	9,321,020	2019	1.726
6	Uzbekistan	49.204	33,580,650	2019	1.465
7	Afghanistan	6.023	38,041,750	2019	158

According to the "Concept for providing the Republic of Uzbekistan with electricity for 2020-2030", it is expected that the annual growth in electricity consumption until 2030 will be 6-7%, the volume of energy generation will increase by 72.3% compared to last year and will reach 120.8 billion kWh, incl. from RES (WPP, WPP, PES) – 31.6 billion kW/h (26.1%). Electric energy consumption per capita by 2030, according to forecast data, will increase to 2665 kWh. per year and at the same time, this indicator is significantly lower than the similar one noted at the end of 2019 in such countries as Korea - 10192 , Russia - 6.685 , China - 5.885 , Kazakhstan - 4.951 , Belarus - 3.458 , Georgia - 3.274 , . Iran - 3.072, Turkey - 3.013 kWh.

In recent years, there has been a trend in the republic towards a systematic increase in decarbonization, the main directions of which are to reduce greenhouse gas emissions, increase energy efficiency and increase the share of renewable energy sources in the energy balance.

According to a survey conducted by the CERR throughout the country at the end of 2021, on average, one family consumes **327 kW** per month, which corresponds to **96.5 thousand** sums. It turned out that consumption also depends on the type of housing of citizens. For example, residents of residential buildings and cottages spent an average of **329 kW**, and apartments - **222 kW**.



Drawing 11. Average electricity consumption by households by regions: 96.5 thousand UZS on average.

As for the uninterrupted power supply factor, the residents of the Navoi region are most satisfied with the quality of services provided by local suppliers. Also, the Republic of Karakalpakstan and the Khorezm region entered the top three in terms of the quality of power supply. The worst situation is in Andijan, Namangan, Surkhandarya and Fergana regions. Residents of these regions often complained about frequent power outages with a frequency of 5 or more times a week.

To date, in terms of electricity consumption per capita, Uzbekistan lags far behind other countries. The government of Uzbekistan is betting on "green" energy as a quick and environmentally friendly solution to the energy shortage. To support the decarbonization process, the state will at some stage be forced to start raising the cost of electricity for the population. At the same time, the most vulnerable segments of the population will be the first to feel the growth of electricity, since, according to the multiplier law, this will all lead to an increase in the cost of goods and services.

To ensure the sustainability and financial stability of energy producers based on green technologies, the key is the existence of tariffs that cover the costs of producers and the renewal of the main fund, as well as income, which serves as a motivation for energy producers in this area. Rising electricity tariffs could put vulnerable segments of the population in an even more difficult position. In this regard, measures are needed to mitigate the effects of the transition to green technologies.

Until the fall of 2019, energy prices were regularly raised twice a year in the republic, but during the pandemic, in order to facilitate the receipt of energy resources by the population and enterprises, at the beginning of 2020, energy prices were frozen at the level of November 2019. In 2022, the Government of Uzbekistan proposed to liberalize energy prices and introduce social norms for their consumption. When developing the document, the social protection of the low-income stratum of the population was taken as the main criterion, first of all, the Ministry of Economic Development noted.

This was provided for by the draft Cabinet of Ministers "On changes in prices for fuel and energy resources", put up for discussion until June 15. The document proposed to establish the size of the social norm for the consumption of energy resources:

- electricity - up to 250 kWh per month;
- gas (in the period from April to September) - up to 200 cubic meters;
- gas (during the heating season from October to March, depending on the season) - up to 700 cubic meters.

The social norm of energy consumption is understood as a certain amount of energy paid by the population at a reduced rate. That is, it is sold at a relatively low (preferential) price up to a certain norm, and above this norm it is sold at market prices.

The draft resolution planned to increase prices for energy resources, including:

1. For electricity:

a) The cost of 1 kWh of electricity for the population is planned to be increased to 325 soums with a consumption of up to 250 kWh per month. For each next kWh above the social norm (more than 250 kWh) the tariff will be 650 soums.

b) The cost of 1 kWh of electricity for budgetary organizations will increase to 800 soums, and for other legal entities - up to 600 soums.

2. For natural gas:

a) The price of one cubic meter of natural gas sold to the population **will** increase to 410 soums with gas consumption within 200 cubic meters from April to September and with a gas meter. If consumption is above the social norm (more than 200 cubic meters), the tariff will increase to 1200 soums.

During the heating season, tariffs will be calculated based on the social norm of 700 cubic meters (410 soums for consumption less than this mark, 1200 soums for more).

b) The cost of one cubic meter of gas for budgetary organizations will increase up to 1300 soums **,** for other legal entities - from 1100 up to 1200 soums **.**

In accordance with the Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated June 30, 2022 No. 348 "On the introduction of market mechanisms in the supply of fuel and energy resources" new prices for fuel and energy resources will come into force on July 15, 2022 and April 1, 2023 . Prices for fuel and energy resources, set from April 1, 2023, will be indexed only by the annual inflation rate in 2024 and 2025, and from 2026 it will move to the wholesale market of natural gas, electricity and liquefied gas, and prices will be freely formed. However, this resolution was temporarily suspended in accordance with the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated July 14, 2022 No. 387 “On the temporary suspension of the Cabinet of Ministers Resolution dated June 30, 2022 No. 348 “On the introduction of market mechanisms in the supply of fuel and energy resources” ' , and has not yet come into effect.

PART II. ROADMAP - A GUIDE TO DECARBONIZATION

Goals and Objectives of the Roadmap

The goal of the Roadmap is determined based on strategic documents, sectoral and sectoral plans, commitments made (in this case, GHG emissions), intentions to achieve the desired state in the development of the energy sector, in particular, growth in the production and consumption of clean renewable energy energy, energy efficiency for the period and for milestone dates for the implementation of the Roadmap activities.

The indicators below are selected from the goals of the Strategy for the transition of the Republic of Uzbekistan to a "green" economy. The “Concept for providing the Republic of Uzbekistan with electric energy for 2020-2030” states that by 2030 the installed capacity of all stations will reach 29.2 GW, of which the share of renewable energy (HPP, WPP, FPP) will be 40.4%, to By 2026, the total capacity of solar and wind power plants in the country will increase to 8 GW, including 5 GW of solar and 3 GW of wind energy.

The target parameters for the further development of renewable energy are planned to increase the share of renewable energy sources in electricity production from 10-12 % in 2018 to 20% by 2025, including hydroelectric power plants - from 10-12% to 15.8%, solar energy - by 2.3% and wind energy - by 1.6%.

By achieving its stated goals, Uzbekistan can preserve domestic gas reserves, as well as potentially use excess renewable energy production to support the development of a hydrogen economy.

The main goal of decarbonization is to achieve carbon neutrality by 2050

Uzbekistan can achieve zero carbon energy as early as 2050, both technically and economically.

Target indicators for the implementation of the Roadmap:

Reducing greenhouse gas emissions

- *reduce specific greenhouse gas emissions per unit of GDP by 35% by 2030 from the level of the base year 2010*

Development of large-scale production and consumption of clean energy

- *increasing the production capacity of renewable energy sources up to 15 GW and bringing their share in the total volume of electricity production to more than 30 percent, as well as reducing the energy intensity per unit of gross domestic product by 30 percent, including through the expansion of the use of renewable energy sources.*

Sustainable financing of RES and EE projects

- *projected investments in the energy sector of Uzbekistan to achieve carbon neutrality average $3.65 billion per year in 2020-2030, $2.28 billion per year in 2030-2040 and $3.48 billion per year in 2040-2050 years*

This indicator was selected from the goals of the "Concept for providing the Republic of Uzbekistan with electric energy for 2020-2030 ", which states that by 2030 the installed capacity of all stations will reach 29,200 MW, of which the share of renewable energy sources (WPP, WPP, PES) will be 40 ,4%.

The target parameters for the further development of renewable energy are planned to increase the share of renewable energy sources in electricity production from 10-12 % in 2018 to 20% by 2025, including hydroelectric power plants - from 10-12% to 15.8%, solar energy - by 2.3% and wind energy - by 1.6%.

As part of the Strategy for the transition of the Republic of Uzbekistan to a "green" economy, it is planned to increase the production capacity of renewable energy sources to 15 GW and bring their share in the total volume of electricity production to more than 30 percent, as well as reduce the energy intensity per unit of gross domestic product by 30 percent, including by expanding the use of renewable energy sources.

4. TASKS AND PROPOSED CHANGES TO IMPROVE POLICIES AIMED AT INCREASING THE GENERATION AND CONSUMPTION OF ENERGY BASED ON RES, THE WIDESPREAD INTRODUCTION OF EE IN THE SECTORS OF THE COUNTRY'S ECONOMY AND REDUCING EMISSIONS

As a result of the work carried out, the actual range of specific tasks that ensure the achievement of the selected priority areas of regulated relations has been determined, detailed solutions to each task have been developed (the regulatory mechanism and its features, the regulatory tools that will be applied, the main measures for the implementation of the regulation option, their sequence and features of implementation of this regulation).

4.1. Development and improvement of regulatory and legal regulation of the use of renewable energy (Annex 1)

Legal status of renewable energy entities. It should be noted that 63.6% of the survey respondents[27] indicated the need to introduce the legal status *of "energy supply organization"* for renewable energy entities. The term "energy supply organization" is used in the Law of the Republic of Uzbekistan "On the use of renewable energy sources" in Chapter 3 (Article 14) and in the Civil Code of the Republic of Uzbekistan in Section 6 "Energy Supply" Chapter 29 "Purchase and Sale" (Articles 468-477), which sets out the conditions for concluding, executing, amending and terminating an energy supply agreement. However, the legal definition of the very term "energy supply organization" in the Civil Code of the Republic of Uzbekistan is not given.

In the Regulations "On the procedure for the supply of electrical energy to consumers" of 2004 (departmental document of the inspection "Uzgosenergonadzor", registered with the Ministry of Justice of the Republic of Uzbekistan for No. 1440 in 2005), the term "Energy supply organization" is defined in the context of a legal entity that has the right to sell and distribute energy under the contract. However, none of the laws of the energy sector of the Republic of Uzbekistan defines this term either.

[27]Here and below, the results of the EHD survey are presented. Detailed survey methodology and results are given in Annex 2: Assessment and analysis of environmental issues, identification of gaps and problems in the use of RES and EE to reduce GHG emissions

In the absence of an appropriate legal status, entities selling electricity generated from renewable energy sources are not entitled to:

- conclude a contract of sale;
- Obtain a license for generation, distribution and sale of energy;
- receive a quality certificate for the generated electrical (thermal) energy.

It seems possible to use the following definition: "Energy supply organization is a commercial organization that sells to consumers both produced and purchased electrical and (or) thermal energy." Such subjects are, among other things, organizations that sell to consumers both produced and purchased electric and (or) thermal energy from renewable energy sources.

The full concept of "energy supply organization" should be contained both in the Civil Code of the Republic of Uzbekistan, since it is of significant importance, and in the sectoral Law of the Republic of Uzbekistan "On the Electric Power Industry", as well as in the context of RES in the Law of the Republic of Uzbekistan "On the Use of RES".

It also makes sense to consider the adoption of the Laws “On Limiting Greenhouse Gas Emissions” and “On Renewable Energy Sources”, which will reflect the system of state accounting for GHG emissions, climate change issues, the rights and obligations of manufacturers and suppliers of equipment for renewable energy, selection and provision energy sites for RES and much more.

Microgeneration based on RES. 54.5% of respondents indicated that there is no definition of the term “microgeneration” in the legislation of the Republic of Uzbekistan. With traditional energy supply, there are many organizational, financial and technical difficulties, and small generation offers solutions that are extremely flexible and fast in terms of increasing capacity. Reasonable and competent linking of small-scale energy and traditional sources of generation will strengthen certain positions of energy security areas by increasing the stability and viability of the power supply system. Using the approach to the emergence of additional energy sources operating on the basis of local renewable energy resources, in the future, can provide a positive general economic effect, and subsequently increase the competitiveness of the economy in the regions of implementation. Since there is no concept of " microgeneration " in the legislation of the Republic of Uzbekistan in the field of energy, there is accordingly no mechanism for implementing measures of state support for the development of microgeneration in non-core entities.

Article 3 “Basic Concepts” of Chapter 1 of the Law of the Republic of Uzbekistan “On the Use of Renewable Energy Sources” introduces the concept of micro and small hydroelectric power plants - water power plants with an installed capacity of up to 0.2 MW and 30 MW, respectively. At the same time, the law does not contain the concept of micro and small generating stations from other renewable energy sources. At the same time, for the implementation of the project, low-power power plants are most in demand, such as solar electric and water heating sources, wind stations, which are most often used in areas remote from centralized energy sources and households to meet their own needs. At the same time, the generating facility is a power plant operating on the basis of renewable energy sources.

According to the definition of the World Union of Distributed Energy (WADE), MICROGENERATION is the use of a decentralized generation facility of low power, sufficient for only one private house. In this case, the surplus of produced energy is transferred to the grid, and the lack of generation is replenished from the grid. Microgeneration should provide, at a minimum, the needs of backup power supply. Restriction to the needs of a private house follows from the very principle of decentralized energy, which provides for the maximum approximation of generation to the consumer. The economic goal and business benefit from microgeneration is the possibility of technological connection to public networks, and the sale of excess generated energy to a guaranteeing supplier.

It should be noted that the term “microgeneration” has been introduced into the legislation of a number of countries.

In the NPA of the Russian Federation, power plants with a capacity of not more than 15 kW are classified as microgeneration, and power plants with a capacity of up to 30 kW in Ukraine. Russian legislation establishes that a microgeneration facility is an electricity generation facility owned or otherwise legally owned by an electricity consumer, which operates, incl . based on the use of renewable energy sources, the installed generating capacity of which does not exceed the maximum power of power

receiving devices, not more than 15 kW. Technological connection of microgeneration facilities can be carried out to electrical facilities of no more than 1 kW. Decree of the Government of the Russian Federation N299, March 2021 "On Amendments to Certain Acts of the Government of the Russian Federation in Part of Determining the Peculiarities of Legal Regulation of Relations on the Operation of Microgeneration Facilities", on the basis of which this concept is legalized. The economic goal of this and the business benefits are that there is a legal possibility of technological connection to public networks and the sale of surplus produced microgeneration energy to a guaranteeing supplier. Tax incentives have been established for microgeneration facilities - the sale of energy by the owner of a generating micro-installation is not considered entrepreneurship and until 2029 is not subject to personal income tax.

Section 2.5. This document provides an economic justification for the expansion of small-scale energy based on the use of renewable energy sources, including in Uzbekistan. As noted in this section in Uzbekistan, small-scale generation based on RES has a huge potential and has already begun to be actively used. Thus, measures are being taken to launch in 2023, along with solar and wind power plants with a capacity of 2,000 MW, in accordance with the Decree of the President of the Republic of Uzbekistan No. PP-57 of February 16 , 2023 "On measures to accelerate the introduction of renewable energy sources and energy-saving technologies in 2023 year" in the country is planned in 2023 the introduction of 47 932 small photovoltaic plants with an installed capacity of 1 480.2 MW. on the roofs of houses and social facilities. These installations represent the actual objects of microgeneration.

In view of the foregoing, it is important to consider the issue of adopting a law "On microgeneration", which will reflect the rights and obligations of the subjects of the microgeneration segment, the basic norm on the cost of electricity produced at microgeneration facilities, and the obligation of the authorized body to purchase this electricity and much more that will be proposed in this section of the Roadmap. This law will be designed to stimulate our microgeneration segment.

Decentralized model for the development of the energy sector. As noted in section 2.5. of this document, electricity generation can be carried out in two ways: centralized and decentralized. Centralized generation is large power plants that serve vast territories (regions, districts), decentralized generation is small stations that serve an individual consumer (a separate household, enterprise). It is also customary to divide the generation of electricity according to the amount of energy generated: large energy (generation of hundreds and thousands of megawatts), small energy (energy generation up to tens of megawatts), mini energy (up to 1000 kW) and micro energy (up to 50 kW). Priority zones and places for the use of RES in Uzbekistan are, in particular, zones of decentralized energy supply, where, due to low population density, the construction of traditional power plants and high-voltage power lines is economically unprofitable or practically unfeasible. The need to use alternative energy sources in Uzbekistan is also related to the fact that many settlements in mountainous and desert regions are too remote and are not connected to the unified energy system. The construction and operation of power plants based on renewable energy sources in these places could solve the problem of electricity supply to the population of these areas.

Article 13 of the Law of the Republic of Uzbekistan "On the Use of RES" establishes the provision of guaranteed connection to the unified electric power system of installations of renewable energy sources, as well as granting the right to enterprises of territorial electrical networks, in agreement with the single purchaser of electrical energy and local government authorities, to conclude contracts for the purchase of electrical energy producers of energy from renewable energy sources.

The "Regulations for connecting to the unified electric power system of business entities producing electrical energy, including from renewable energy sources" (PKM No. 0.23-0.4 kV for owners living in an individual residential building, coordination of the connection project with the Uzenergoinspektsiya or its territorial branches is not required, verification of compliance with technical conditions and connections to electrical networks are carried out by an authorized representative of the owner of the networks without the participation of a representative of the Uzenergoinspektsiya or its territorial branch. At the same time, obtaining permission from the Uzenergoinspektsiya for the admission of electrical installations of the manufacturer into operation is not required.

At the same time, 45.4% of EHD participants noted the absence in the legislation of the Republic of Uzbekistan of a mechanism for connecting renewable energy facilities to centralized electric networks

and the possibility (supply) of selling electric energy to the energy system, in the absence of these networks in remote mountainous areas of decentralized energy supply.

The Law does not answer the question of how the authorized body in the field of energy organizes the purchase of electricity from the owner of a power plant in the zone of decentralized energy supply, if the authorized body (energy supply organization) does not have electrical distribution networks. There is no answer about the construction and maintenance of a local distribution electrical network when generating capacities exceeding microgeneration (over 50 kW), about the role of the authorized body in this process, about the mechanism for buying electricity and selling it to households. Also, a model contract for the sale of energy to a consumer, as well as a model contract for servicing a local distribution electrical network, have not been developed. There are no accounting mechanisms for purchasing energy from microgeneration sources from renewable energy sources.

Development and implementation of standards for the use of RES and EE, regulations and rules. The development and implementation of standards for the use of renewable energy, regulations and rules is an important task in the field of decarbonization and increasing the share of renewable energy in the country's energy balance. This will ensure a unified approach to the design, construction and operation of renewable energy facilities, as well as improve their efficiency and reliability.

The issues of standardization in the field of renewable energy, energy saving, and energy efficiency are regulated by the laws of the Republic of Uzbekistan “On standardization”, “On the use of renewable energy sources”, “On the rational use of energy” and “On the electric power industry”. According to the quality standards of electrical energy in general-purpose power supply systems in Uzbekistan, the interstate standard GOST 32144-2013 is used, which corresponds to the European regional standard EN 50160:2010 Voltage characteristics of electricity supplied by public distribution networks (Characteristics of the voltage of electricity supplied by public distribution networks). The degree of conformity is non-equivalent (NEQ). The standard was developed based on the application of GOST R 54149–2010. The existing standards mainly relate to electricity generated by traditional energy machines and in some respects do not meet the specifics of microgeneration based on renewable energy sources.

However, the development of the entire required package of regulatory and technical standardization documents has not been completed, which hinders the proper and high-quality development of the use of renewable energy, energy saving and EE. In addition, when developing standards for RES, it is necessary to take into account the concept of " microgeneration " due to its absence in the country's legislation.

Development and adoption of the necessary by-laws for the implementation of the law of the Republic of Uzbekistan "On the use of renewable energy sources". During the FGD, it was noted that the widespread introduction of installations for the use of renewable energy sources began to reveal the absence of the necessary by-laws on the implementation of the Law of the Republic of Uzbekistan “On the use of renewable energy sources”. 18.2% of participants noted the absence of:

- register of RES resources in the country.
- regulations on the allocation of land for the construction and installation of power generating stations using renewable energy sources.
- model contracts for the purchase and sale of energy to the authorized body.
- standards for the creation and operation of local electrical networks, standard contracts for the purchase and sale of energy through these networks.
- standards for certification of energy produced from renewable energy sources and produced by installations on renewable energy sources.

54.6% of FGD participants noted the absence in the legislation of the Republic of Uzbekistan of a mechanism for accounting for energy produced from renewable energy sources and installations of renewable energy sources. It was also noted that there was no format for a certificate on the use of renewable energy sources with a complete disconnection from existing energy networks, issued by an authorized organization.

4.2. Improvement of tariff regulation, measures of tax and customs regulation, and development of financing measures for state support of microgeneration from renewable energy sources (Annex 1)

Improving the issues of tariff regulation

The survey of respondents revealed that one of the most impeding factors for the development of renewable energy in the Republic of Uzbekistan is tariff regulation (36.4%). More than 27% of respondents indicated an imperfect legislative framework, tariff and fiscal policy in the field of RES and EE as the problem that most hinders the development of the use of RES and the growth of EE.

To improve the issues of tariff regulation of RES in the Republic of Uzbekistan in accordance with the Law "On the use of renewable energy sources" and other regulatory legal acts, the following measures are provided:

- when setting tariffs for electricity for end consumers, all costs for the purchase of electricity from all sources of production, including renewable energy, are taken into account, as well as tariffs for electricity produced from renewable energy, are determined on the basis of competitive bidding;

- from August 1, 2020, the tariff for guaranteed purchase of electrical energy by enterprises of territorial electrical networks from newly commissioned small renewable energy sources with an installed capacity of up to 1 MW, including surplus electrical energy produced for their own needs, is set at the level of the II tariff group of consumers, excluding all costs associated with transportation, distribution and marketing, since October 1, 2022, the state has been purchasing surplus electricity (in the amount of 80 percent of the tariff established for the II tariff group of consumers), produced at solar, wind and biogas power plants with a capacity of up to 1 MW, established individuals and legal entities for their own needs, for at least ten years, as well as making appropriate changes to the tariffs for the purchase of electricity based on the results of the revision of tariffs set for end consumers.

- determining the price of potential investors for the implementation of projects in the field of renewable energy sources (except for hydroelectric power plants) on an industrial scale (1 MW or more) is carried out through transparent auction (competitive) bidding;

- from October 1, 2022, electricity generated at hydroelectric power plants with a capacity of up to 5 MW is purchased in a guaranteed manner by Regional Electric Grids JSC and the body authorized by the state to exercise the function (authority) of purchasing electricity, while the initial price in relation to tariffs for consumers Group II is set in the amount from 150% to 100% for the capacity of hydroelectric power plants starting from up to 500 kW and finishing up to 5 MW;

- from April 2020, the introduction of a system of differentiated tariffs (block tariff) for end consumers with an increased rate for excess consumption of electricity, natural gas and hot water for electricity, natural gas and hot water;

- from 2020, improve the tariff policy with the approval of marginal (maximum allowable) tariffs for the purchase of electricity from newly commissioned objects of renewable and secondary energy sources (solar, wind, biogas stations) in order to create a favorable competitive environment in the renewable energy market.

- from April 2023, the sale of surplus electricity received from a small solar station to budgetary organizations for 800 UZS / **kWh***, at a tariff price for consumers of group II equal to 450 UZS / kWh , individuals who have installed solar stations in their homes will be able to sell excess* **electricity** *at a price of 1000 UZS/ kWh* **,** *with a tariff price of 295 UZS / kWh .*

It should be noted that renewable energy has received the greatest development after the appearance of a preferential fixed "green tariff" (feed-in tariff), which helped to increase the profitability of both generating companies and small generation based on renewable energy and is the most common support measure. The accumulated experience in the world allows us to talk about fixed tariffs as the most successful measures to stimulate the development of renewable energy sources. **Currently, the feed-in tariff is applied in 98 countries of the world.** This is one of the earliest methods in this area and

has been proven to be the most effective method to ensure that all producer costs are covered, subject to a certain rate of return.

These RES support measures are based on three main factors: a guarantee of connection to the grid, a long-term contract for the purchase of all electricity produced by RES and a guarantee of purchase of electricity generated at a fixed price. Fixed tariffs for RES energy may differ not only for different renewable energy sources, but also depending on the installed RES capacity. One of the options for a support system based on fixed tariffs is the use of a fixed premium to the market price of RES energy. As a rule, a surcharge to the price of electricity produced or a fixed tariff is paid over a sufficiently long period (10-20 years), thereby guaranteeing a return on investments invested in the project and making a profit.

Consider examples of the introduction of the "green tariff":

Table 9. Fixed tariff in EU countries for solar power plants

A country	*Power*	*Tariff, euro/kW*	*For a period of*
Austria	*5-200 kW*	*€0.12*	*13 years*
Serbia	*up to 50 kW*	*€0.17*	*12 years*
Bulgaria	*up to 5 kW*	*€0.11*	*20 years*
Croatia	*up to 10 kW*	*€0.26*	*14 years*
France	*36 kW*	*€0.14*	*20 years*
Germany	*up to 10 kW*	*€0.12*	*20 years <*
Lithuania	*up to 10 kW*	*€0.16*	*12 years*
Spain	*up to 20 kW*	*€0.28*	*30 years*
Switzerland	*up to 30 kW*	*€0.22*	*25 years*
Great Britain	*up to 4 kW*	*€0.12*	*25 years*

*In 2000**, Germany** took steps to stimulate the production and use of photovoltaics. A system of special purchase tariffs (feed-in-tariff) for photovoltaic producers, independent of the state budget, was adopted, according to which the state purchases electricity generated by photovoltaic converters during the day at a price of 99* **German pfennigs (= 0.65 euros) per 1** *kW h from the owners of photovoltaic solar modules, and in the evening and at night, the energy system already gives its consumers (the public) the amount of electricity they need at a price of 20 German pfennigs (= 0.13 euros) per* **1** *kWh . At the same time, an almost interest-free loan for 10 years was available for buyers of photovoltaic solar modules with a capacity of up to 5 kW.*

The new Law on Renewable Electricity Sources, adopted on October 25, 2008, established the following tariffs for electricity from solar radiation installations:

- with power up to 30 kW inclusive - at least 43.1 cents **per** *kWh;*

- starting from a power of 30 kW - a minimum of 40.91 cents **per** *kWh;*

- starting from a power of 100 kW - at least 39.58 cents **per** *kWh.*

At the same time, **the** *minimum tariff for electricity obtained from solar radiation installations is 31.94 cents per kWh, and the guaranteed period of tariffs is 20 years [28].*

*In **the United States**, for incentive programs for small generation based on RES, the amount of subsidies for the installation of solar panels (with a maximum panel capacity of 1000 kW) is $ 0.28 / W, but not more than $ 7,000 for the residential sector and not more than $ 25,000 for commercial sector, and the purchase of electricity from small solar power plants with a capacity of 30 kW to 3000 kW is carried out at an average tariff of 17 cents per* **kWh and** *varies depending on time and season, while the maximum tariff is 38 cents per kWh .*

[28] Z.U. Saipov, G.A. Arifjanov. Small renewable energy in the prism of foreign experience. Economic review. № 5 (257) 2021

Fixed tariffs in ***Kazakhstan are established in accordance with the Decree of the Government*** *of the Republic of Kazakhstan dated June 12, 2014 No.* **645** *"On Approval of Fixed Tariffs" for the supply of electricity produced by renewable energy facilities, including: 14.9 cents per kWh for wind farms, 22, 8 cents/* **kWh** *for solar, 11.0 cents/ kWh* **for** *small hydro, and 21.2 cents* **/** *kWh for [29]biogas plants.*

At the same time, electricity generated at RES facilities is bought from producers within 15 years after the start of commercial operation at an inflated "green tariff" in accordance with the types of RES and sold to the population by the national operator at general tariffs.

According to paragraph 2 of Article 8-1 of the Law "On Support for the Use of RES", fixed tariffs are annually indexed to inflation.

In 2017, the tariff indexation method was revised to manage exchange rate volatility for investors and, starting October 1, 2017, tariffs for generated electricity were set at 8.7 cents per kW. h for wind farms, 13.3 cents per kWh **for** *solar power plants and 6.4 cents per* **kWh** *for small hydropower plants.*

In view of the foregoing, for the development of RES in the Republic of Uzbekistan, it is advisable to consider the issue of establishing fixed tariffs for electricity produced by facilities using renewable energy sources.

Improving the measures of tax and customs regulation.

According to Article 13 of the Law of the Republic of Uzbekistan "On the Use of RES", as state support in the field of the use of renewable energy sources, the establishment of tax, customs and other benefits and preferences in the field of the use of renewable energy sources and when importing RES installations is provided.

Article 14 of this law defines the following benefits and preferences in the field of the use of renewable energy sources:

- producers of energy from renewable energy sources are exempt from paying property tax for installations of renewable energy sources and land tax on sites occupied by these installations (with a nominal capacity of 0.1 MW or more) for a period of ten years from the date of their commissioning.

- the tax on the property of individuals is not levied on property owned by persons using renewable energy sources in residential premises with a complete disconnection from existing energy networks for a period of three years starting from the month of using renewable energy sources.

- Persons using renewable energy sources in residential premises with a complete disconnection from existing energy networks are exempted from land tax for a period of three years starting from the month of using renewable energy sources.

According to the Decree of the President of the Republic of Uzbekistan No. PP-57 dated February 26, 2023, the following benefits are provided for legal entities and individuals on property and land taxes, and benefits for legal entities on income taxes:

from April 1, 2023, individuals and legal entities that have installed renewable energy installations with a total capacity of up to 100 kW are exempt.

- from the payment of property tax - according to these settings,

- from the land tax - on the plots occupied by these installations,

- profit tax - accrued on profit for electricity sold by legal entities for the general network, from the date of their commissioning - for a period of three years,

- in the case of their installation with an electric energy storage system with a capacity of at least 25 percent of the capacity of the installed solar panels - for a period of up to ten years;

from March 1, 2023, when connecting to the electric grid installations of renewable energy sources that do not exceed the capacity specified in the technical specifications issued for connection to the unified electric power system, no additional technical specification is required.

[29] Z.U. Saipov, G.A. Arifjanov. Small renewable energy in the prism of foreign experience. Economic review. № 5 (257) 2021

Also, in order to stimulate the use of alternative energy sources, the President signed a decree on the introduction of the "Green Energy" certificate system, on the basis of which, from July 1, a "green" certificate will be issued to hydroelectric power plants. This system will apply from October 1 to all electricity generated from renewable energy sources.

At the expense of the Entrepreneurship Support Fund, all trade and service enterprises will be provided with compensation of 4 percent of loans allocated for the installation of solar panels. 100 million dollars will be attracted from international financial organizations for further allocation of preferential loans to the population and entrepreneurs.

Responsible persons were instructed to introduce this system, encourage the population and entrepreneurs, government departments and social institutions to install small solar panels.

At the same time, 45.5% of FGD participants noted that components for RES installations are subject to VAT and customs duties, while in most countries equipment for RES is exempt from VAT and customs duties.

According to the results of the survey, 63.6% of respondents spoke in favor of the abolition of VAT on equipment and related products, spare parts and operating materials for the operation of renewable energy, and another 10% for the abolition of VAT on all goods used to obtain renewable energy and increase energy efficiency, which are not produced in the territory Republic of Uzbekistan. The participants also noted as a good factor the increasing number of electric vehicles and the need to increase charging stations for electric vehicles, especially on intercity routes. At the same time, it was noted that it is necessary to apply the existing preferences issued to the owners of charging stations, depending on the power source used: from the network or from an autonomous station using renewable energy sources.

As part of the Strategy for the transition of the Republic of Uzbekistan to a "green" economy, as well as further expansion of the use of renewable energy sources *(RES)* and resource conservation in all sectors of the economy, the following proposals are proposed:

- Conduct an analysis (inventory, monitoring) of the current fiscal system of the state in the field of RES use and determine the effectiveness of the benefits provided.

- Based on the results of the analysis (inventory, monitoring) , develop a comprehensive system of customs and tax benefits aimed at supporting:

- import of relevant machinery, technology, equipment and components;
- production (localization) in the field of renewable energy;
- sale and export of equipment in the field of renewable energy;
- population and enterprises in the use of renewable energy.

Development of financing measures, including “green finance”

The survey of respondents revealed that for the development of renewable energy, the majority mainly use their own funds (53%), state grants and preferential targeted loans (47 %), as well as in the presence of “cheap and long loans” at an acceptable rate, they are ready to invest in renewable energy (19%).

In the course of the survey, when asked about their readiness to invest in the renewable energy sector, 44% of the total number of respondents answered that they were ready to invest if there were free funds and resources available; 19% expressed their willingness to invest, if there are "cheap and long loans" at an acceptable cost; 13% indicated their willingness in the event of the creation of legal and economic conditions that allow them to extract additional profit. When asked what problems most impede the development of the use of renewable energy sources and the growth of EE, 36.36% of respondents point to weak investment attractiveness and low business activity in introducing technologies and setting up production in the field of RES and EE. 45.45% each note weak state support and insufficient stimulation of the industry and limited access to information about renewable energy.

To finance RES in Uzbekistan, in accordance with the Law “On the Use of Renewable Energy Sources” and other regulatory legal acts, the following measures are provided:

- funds of the republican budget of the Republic of Uzbekistan, the republican budget of the Republic of Karakalpakstan, local budgets of regions and the city of Tashkent, own funds of individuals and legal

entities, as well as preferential credit resources of international financial institutions and foreign government financial organizations, funds technical assistance (grants) from foreign donors

- from January 1, 2020, the following activities are financed from the State budget of the Republic of Uzbekistan within the annually approved parameters:

a) providing individuals with compensation in the amount of 30% of the cost of purchasing solar photovoltaic stations (no more than 3 million soums) and solar water heaters (no more than 1.5 million soums), as well as from October 1, 2022, the amount of compensation for the installation of solar or a wind farm is from 7 to 50 times the basic design value with an installed capacity of 0.5 kW to 5 kW, and for the installation of solar water heaters from 5 to 7 times the basic design value with an installed volume of water heating from 100 to 200 liters.

b) providing individuals and legal entities with compensation to cover interest expenses on loans from commercial banks for the purchase of renewable energy installations:

individuals - for loans, the amount of which does not exceed 500 million soums - in the part exceeding the refinancing rate of the Central Bank of the Republic of Uzbekistan, but not more than 8% points;

legal entities - for loans, the amount of which does not exceed 5 billion soums - in the part exceeding the refinancing rate of the Central Bank of the Republic of Uzbekistan, but not more than 5% points;

- ensure the installation of RES installations for needy families included in the Iron Notebook (at the rate of one installation of a solar photovoltaic power plant with a capacity of up to 1 kW and (or) one unit of a solar water heater with a volume of at least 100 liters per household) in 2022 - for from additional sources of local budgets, in 2023 - from the funds provided for in the parameters of local budgets for these activities (in 2022 - 20 percent of families in need, in 2023 - 80 percent).

Currently, the policy in the field of financing renewable energy in the world is quite diverse. Among them, there are such RES support measures as loans, grants, subsidizing the cost of borrowed capital, etc. Some of them have already proven to be effective and understandable to market participants. One of the effective measures is the reimbursement of the cost of technological connection. To increase the investment attractiveness of projects based on RES, state bodies may provide for a mechanism for partial or full compensation for the cost of technological connection of renewable sources to the grid.

*For example, in 2000, **Germany** took measures to stimulate the production and use of photovoltaics. At the same time, an almost interest-free loan for 10 years was available for buyers of photovoltaic solar modules with a capacity of up to 5 kW.*

*Good indicators of RES development are observed in **Kazakhstan**, which is the only country in the region where RES are actively subsidized by the state. The Law "On Supporting the Use of RES" provides for a state compensation rate of 50% of the costs of an individual user who does not have a connection to the grid for the purpose of purchasing RES installations from a Kazakh manufacturer with a capacity of not more than 5 kW.*

Development of measures to stimulate demand for products of national manufacturers-suppliers of equipment, systems of new energy-efficient technologies and services using renewable energy sources for the purpose of decarbonization.

36.4% of respondents noted the insufficiency of incentive measures to reduce the tax burden and payments for new energy efficient technologies and services using renewable energy before starting operations and generating income, and 21.4% noted weak state support and the lack of economic and legal incentives for the use of renewable energy.

Table 10. Measures to stimulate energy efficient technologies and services using renewable energy sources in various countries

A country	Incentive measures			
	Bonus rate	Grants and subsidies	Carbon Market Mechanisms	tax incentives

Belgium	---	---	Micro-cogeneration, electricity generation based on RES	Biogas, biomass, solar, geothermal, micro-cogeneration
Great Britain	Generation of electrical and thermal energy based on RES	Thermal energy generation based on RES	Micro-cogeneration, electricity generation based on RES	All types of RES
Germany	Electricity generation based on RES, micro-cogeneration	Micro cogeneration	---	All types of RES, micro-cogeneration
Holland	Generation of electrical energy based on RES	Micro cogeneration, solar collectors	---	---
Italy	Electricity generation based on RES, solar collectors, biomass	---	Micro-cogeneration, electricity generation based on RES	---
Canada	Generation of electrical energy based on RES	Solar collectors	-	All types of RES
China	-	Generation of electrical energy based on RES	-	Generation of electrical energy based on RES
USA	Generation of electrical energy based on RES	Generation of electrical and thermal energy based on RES	Generation of electrical and thermal energy based on RES	-
Japan	-	Fuel cells, photovoltaics	Generation of electrical energy based on RES	All types of RES, micro-cogeneration

Since the 1970s, governments in many countries have funded various research and development programs aimed at developing alternative energy technologies . Such programs have been continued in the form of various market incentive schemes, including investment incentives, tax incentives, preferential favorable tariffs. In the late 90s, many countries began experimenting with green certificates. Significant growth in renewable energy markets has been observed in countries where various incentive measures have been applied in combination, rather than any one mechanism.

For example, in Japan, photovoltaics has been supported by large research support programs that have made the technology competitive in the energy market. There were also public campaigns that raised public awareness of the possibilities and benefits of photovoltaics, financial incentives were introduced that lowered the cost of photovoltaic systems for the end consumer, as well as energy supply companies, were required to buy (receive) electricity generated by solar panels.

In Spain, wind energy is supported by both socially important goods (SZT) and low-interest loans, grants for capital investments , and local manufacturers of wind turbines are also supported .[30]

[30] https :// lifxil.en/vetroenergetika - ispanii/

In no case is there a noticeable increase in the use of renewable energy technologies if only one incentive mechanism is applied. RES support mechanisms should create more favorable conditions for renewable energy, which is currently unable to compete with traditional fossil fuels. Moreover, traditional energy currently receives significant subsidies from the state . The price of electricity and energy carriers does not include external costs (ecology, waste processing , land restoration, etc.) and therefore the methods for determining the economic efficiency of the use of renewable energy sources that are currently used are not correct.

Long term and the predictability of renewable energy support policies is a very important point for the success of renewable energy development. In most countries that use NWT, such tariffs are set for a period of 8 to 20 years.

The national incentive policy should be supported by regional measures to stimulate renewable energy. For example, in the United States, despite the fact that there is a federal development program RES, a number of states are implementing their programs for the development of RES, and even more states have introduced additional financial incentives for RES.

The situation with the use of renewable energy in Europe, the United States and other countries once again shows that the development of renewable energy is not an economic or geographical issue. The determining factor is the availability of incentive mechanisms for the use of renewable energy sources. Given the political will of the government, the emergence of economic mechanisms is a natural consequence.

A legal analysis of the legislation of various countries allows us to conclude that, in general, measures to stimulate the use of renewable energy sources include:

1) Fixed tariff for renewable energy projects.
2) Green certificates.
3) Tax incentives.
4) Benefits related to technological connection to the network.

According to the experience of European countries, for a number of years, applying various RES, there are the following main forms of incentives:

- subsidizing investments in renewable energy
- tax exemption and reduction of tax rates
- establishment of special guaranteed tariffs for the purchase of electricity produced from RES, as well as obligations for energy networks to purchase this electricity
- establishment of a mandatory share of electricity produced from RES in the balance of electricity sold by power grids
- financing of R&D leading to a reduction in the cost of renewable energy
- creation of state and other institutions to promote renewable energy
- implementation of special programs and demonstration projects
- concessional loans for the purchase of renewable energy equipment and partial return on investment for consumers
- accelerated depreciation of equipment for renewable energy
- adoption of laws regulating the conditions for access to energy systems for RES installations
- organization of public support and the introduction of voluntary forms of support, such as the purchase of "green energy" by consumers, as well as the transparency of information on the share of green electricity in the balance of energy networks
- establishment of a tax on fossil fuels taking into account $CO_{2\ \text{emissions}}$ or a tax on electricity produced from fossil fuels.

To stimulate the introduction of RES in Uzbekistan, in accordance with the Law and other regulatory legal acts, the following exemptions are provided:

- until January 1, 2022 from customs payments (excluding customs fees) of equipment, raw materials and materials, components, appliances, spare parts not produced in the republic for renewable energy;
- all types of taxes for a period of five years from the date of state registration of producers of RES installations;
- property tax for RES installations and land tax on sites occupied by these installations (with a nominal capacity of 0.1 MW or more), for a period of ten years from the date of their commissioning;
- land tax by persons using renewable energy in residential premises with a complete disconnection from existing energy networks for a period of three years, starting from the month of using renewable energy.

Individuals are given the opportunity to purchase installations of solar and wind power plants and solar water heating devices manufactured in the republic, with payment in installments without interest for 3 years at the expense of the Extrabudgetary Intersectoral Fund for Energy Saving under the Ministry of Energy, and part of the costs of consumers who paid the full cost, purchased and installed RES installations, is compensated at the expense of the Fund in the amount according to the amount of compensation.

4.3. Public control and ensuring the effective participation of local communities, civil society, the private sector, the media to control and monitor the implementation of strategic documents on the decarbonization process (Annex 1)

Activation of the activities of Public Councils in state authorities, civil society and other stakeholders to monitor and review decarbonization processes

Public councils in state authorities are an important mechanism for providing feedback between state bodies and the public. They help to increase the transparency and openness of the activities of state bodies, as well as improve the quality of decisions made. In recent years, Uzbekistan has been actively working to intensify the activities of Public Councils in government bodies. For this purpose, the Decree of the President of the Republic of Uzbekistan “On measures to organize the activities of public councils under state bodies” dated July 4, 2018 No. 3837 was adopted, which provides, among other things, for the mandatory inclusion of representatives of civil society in the Public Councils under state bodies.

During the FGD to discuss the implementation of the program for the decarbonization of Uzbekistan, it was noted that the country's civil society is increasingly active and supported by the government. In order to improve the efficiency of the work of public councils, various training and information events were organized for their members. Electronic platforms have been created for the exchange of information and experience between public councils. Also, government bodies interact with public councils through various formats: holding meetings, round tables, forums, conferences, and other events. At the same time, FGD participants noted the need to create public councils for the examination of projects (public examination of projects), to use the work of all components of public control with the participation of civil society, to establish cooperation between civil society and the environmental committees of the Senate and the Oliy Majlis, to intensify the activities of public councils under Khokimiyats , at the meetings of which to consider the issues of landfills as a source of environmental pollution and the development of corruption. In general, it was noted that the activation of public councils in government bodies is an important step towards the further development of democratic processes and increasing the level of citizens' trust in state institutions. It was also expressed about the need for wider involvement of representatives of civil society, NGOs in the work of public councils in the context of the decarbonization process.

Enhancing the activities of civil society and other stakeholders in monitoring and expertise is an important element of civic participation in the decarbonization and climate conservation program. This allows citizens and other stakeholders to monitor the activities of government agencies, detect problems and errors in their work, and propose solutions to eliminate them. Various activities are being carried out in Uzbekistan to enhance the activities of civil society and other stakeholders in monitoring and expertise. One of such measures is the creation of open platforms for public discussions of draft regulations and other important issues related to the introduction of renewable energy and energy efficiency. This allows

citizens and experts to express their opinion and evaluate decisions made by government bodies. Also, public councils are being created in the country under many state bodies, which include representatives of civil society and other interested parties. These councils monitor the activities of the authorities and make proposals for their improvement.

According to Article 10 of the law "On the Use of RES", self-government bodies of citizens, non-governmental non-profit organizations and citizens can participate in the development and implementation of state and other programs in the field of the use of renewable energy sources; assist in the implementation of measures for the use of renewable energy sources; exercise public control in the field of renewable energy sources. Therefore, the activation of civil society and other stakeholders in monitoring and reviewing decisions on the implementation of the Law of the Republic of Uzbekistan "On the use of renewable energy sources" is an important step towards strengthening democracy and improving the quality of this implementation.

4.4. Awareness of communities, the population of the country, civil society and other stakeholders on decarbonization issues (Annex 1)

Access to the information. Raise awareness population and increased media activity on decarbonization issues

Recently, Uzbekistan has been actively working on decarbonization of the economy and the transition to more environmentally friendly types of production and energy. The awareness of communities, the population of the country, civil society and other stakeholders on decarbonization issues is an important condition for the successful implementation of this process. Various activities are being carried out in Uzbekistan aimed at informing the general public about the need for decarbonization and about what steps are being taken to implement it. One of such activities is holding public discussions and consultations on decarbonization issues. These events allow citizens and other stakeholders to express their opinions and offer their ideas for the implementation of this process. It is necessary to create special information resources where information about decarbonization and related issues should be published. For example, on the website of the Ministry of Energy of the Republic of Uzbekistan, it is not always possible to find information about projects related to the transition to environmentally friendly energy sources. In general, informing communities, the population of the country, civil society and other stakeholders on decarbonization issues is an important element of its successful implementation.

An important element in the activation of civil society and other stakeholders is access to information. In Uzbekistan, legislative and regulatory acts have recently been adopted that ensure the transparency of the activities of state bodies and oblige them to provide information about their work. In addition, special portals and electronic resources have been created, which publish information about the work of state bodies and ongoing events. As part of various decarbonization activities, government agencies and other stakeholders should publish information about their activities on special Internet resources and social networks. Access to information is the right of citizens to receive information that is at the disposal of state and non-state organizations and institutions, as well as to freely distribute and use it in accordance with the law. Also, in Uzbekistan there are independent environmental organizations that are engaged in research and monitoring of the environmental situation in the country, including decarbonization issues. Their reports and research are available to the public. In general, citizens have access to information about decarbonization in Uzbekistan, and government agencies and other stakeholders are making efforts to ensure openness and transparency in this area.

At the same time, during the FGD, it was expedient to create a portal with accessible information on all issues of decarbonization, to provide brief information on GHG emissions in such sectors as agriculture, industry, housing and communal services, energy, and transport. Assessing the availability of information, 54% of respondents during the survey answered that there is not enough information to make a decision on the use of technologies, materials, generating equipment, devices that ensure energy efficiency, only 4% note in their answers that information is available on the Internet, the media, resources of line ministries. When asked which of the problems most hinder the development of the use of RES and the growth of EE in the sectors of the economy of the Republic of Uzbekistan, 45.45% of respondents answered that access to information on RES and EE and the reduction of emissions is limited. At the same time, 37.5% of respondents noted that the lack of reliable statistics and research results on the use and

state of the business environment in the supply of materials, generating equipment, devices that reduce emissions, increase EE and use RES by business entities reduce the quality of analysis and determining the scale of problems and their impact on the sector, and the same number of respondents (37.5%) noted that they reduce the quality of developing sound investment projects and creating a favorable business and investment environment. According to the results of the survey, 90.9% of respondents indicated that they were not well aware of the benefits of using REEE. It was emphasized that little attention is paid in the media to informing the public about the benefits of using REEE. 54.6% of respondents spoke in favor of improving educational work directly in mahallas and villages, 18.2% spoke in favor of a wider coverage of the practical results of the use of renewable energy through television and social networks, paying particular attention to the issues of decarbonization in the communal sector and in the field of handling household waste, as these two sectors have the largest coverage of the population of the republic. It was proposed to develop and implement appropriate training programs in universities and secondary educational institutions (schools), to organize appropriate broadcast cycles on television with the participation of scientists, environmentalists, and renewable energy specialists.

4.5. Measures to mitigate the negative impact of decarbonization on vulnerable segments of the population

The new version of the Constitution, adopted in 2023, separately enshrined the constitutional obligations of the state to further ensure the protection of the honor and dignity of a person, and social support for the population. In the light of this decision, the state raises large-scale work in the field of poverty reduction to a new level and steadily continues reforms in all directions, based on the principle of “human - society - state”.

First of all, the most favorable conditions are created for the private sector and entrepreneurship, which are the “driver” in creating new jobs and increasing the income of the population, and active entrepreneurs who initiated the training and employment of unemployed citizens will be provided with a package of additional benefits under the “social contract” system.

Secondly, the implementation of targeted support programs for poor families within the framework of the “social register” system using an individual approach will continue at an accelerated pace.

Thirdly, in order to fully implement the social obligations of the state, more than a hundred social services will be provided to persons with disabilities, women, representatives of the older generation, categories of citizens in need of special attention.

Fourthly, in order to improve the infrastructure of mahallas, the amount of funds allocated through the “open budget” system for projects chosen by the population will be dramatically increased.

Fifth, in order to develop human capital, work will be expanded to ensure the rights of everyone to have access to quality education and health services.

The Center for Economic Research and Reforms (CERR), together with the Agency of Statistics under the President of the Republic of Uzbekistan (Statistical Agency), assessed the change in the level of well-being of the population of Uzbekistan for 2021-2022 . based on household budget survey data across the country. According to experts, the poverty rate in Uzbekistan in 2022 decreased from 17% compared to the previous year and amounted to 14%.

Through the expansion of social services in the mahallas of the country, more than 2 million 300 thousand families in need, women, single elderly and persons with disabilities are fully covered by the social protection system. If we take into account that about 5 million people in our country are in a state of poverty, which means that their daily income does not exceed 10-13 thousand soums, then it is necessary to work out the issue so that all this population receives state social services. Including to ensure the installation of renewable energy equipment for this population (based on one installation unit of a solar photovoltaic power plant with a capacity of up to 3 kW and one unit of a solar water heater with a volume of at least 200 liters per household).

Drawing 12. Poverty assessment in Uzbekistan for 2022

At the II International Forum on Poverty Reduction in Tashkent, the government of the country identified four main areas for combating poverty in Uzbekistan. I take into account that the majority of the vulnerable population of the republic lives in rural areas, the following directions have been adopted:

- First of all, the development of agriculture and the development of entrepreneurship in the countryside.

- The second direction in the fight against poverty is the development of industry in rural areas.

- the third direction is the development of infrastructure and includes providing the population with the help of green technologies with drinking water and electricity.

- the fourth direction is urbanization, that is, a shift in the focus of development from the countryside to the city and the retraction of the village into the city.

Since one of the main directions is the provision of electricity, without which it is impossible to live and work normally. In recent years, almost all energy sources have been subsidized by taxpayers. Gasoline, electricity, and natural gas all sell for less than the "real" price, with taxpayer money covering the price difference. According to International Energy Agency, Uzbekistan spent $5.24 billion on energy subsidies in 2017 and, for comparison, $2.43 billion was spent on education from the budget in 2018.

The current tariffs for energy resources, which are not formed on the basis of market mechanisms, hinder the development of the energy industry and do not allow covering the needs of consumers. In this regard, it is necessary to introduce social norms for the population for electricity and gas, and to sell the volume consumed in excess of it at market prices. At the same time, to establish the size of the social norm for the population for electricity consumption - up **to** 500 kWh per month.

It should be noted that in the social aspect, decarbonization also brings new opportunities for communities that do not have constant and uninterrupted access to electricity. The opportunity to access alternative energy sources within their own communities can become a reality through the introduction of green technologies, but for this a number of measures must be taken to mitigate the impact of the decarbonization process on vulnerable segments of the population:

- Stimulating the development of microgeneration. One of the main social tasks today is the reliable supply of electricity, especially to those consumers located in areas of decentralized power supply. For these consumers, the use of small RES generation, including microgeneration is the

most promising direction, which will increase the reliability of energy supply, lead to the creation of new jobs, the formation of prerequisites for reducing the consumption of fossil fuels and environmental pollution.

- Creating an opportunity to obtain a new specialty for specialists who are left without work due to the transfer of production to green technologies. For example, the refusal to burn coal by an enterprise can lead to a reduction in the jobs of workers engaged in loading, direct combustion of coal and removal of waste waste. At the same time, there is a need for technicians capable of repairing and installing alternative energy systems.
- Stimulate investment in micro-generation enterprises. Currently, various measures are being taken by the state to encourage citizens to use and install alternative energy sources in order to somehow mitigate the problem of insufficient and unstable energy generation. To do this, communities must have access to sources of concessional financing or be able to attract investments themselves, including from budgetary sources, including local budgets, to install installations for microgeneration of electricity.
- Development of public-private partnership at the local level. To accelerate the development of RES at the local level, the widespread use of public-private partnerships as a way to organize microgeneration of electrical energy can also be an effective measure aimed at mitigating the consequences of the decarbonization process for vulnerable segments of the population.

Enormous work remains to be done to ensure the sustainable access of the entire population of the country to safe and cost-effective modern energy sources. A successful energy transition will depend on the availability of effective policies and innovative technologies, as well as the massive mobilization of capital for investment. In this context, the measures proposed in the Roadmap are aimed at the implementation of these tasks.

4.6. Development of eco-construction technologies

Saving energy resources in the modern world is one of the most urgent tasks. According to experts, half of the energy received is spent on residential buildings and structures. The construction of energy efficient buildings is becoming a priority. Experts argue that the construction of energy-efficient buildings can be of great help in combating the coming financial (and possibly economic) crises. The last decades show that this statement has more and more the right to life: the prices for electricity and heat are rising, the issue of operating costs for housing is acute. And this process is gaining momentum.

According to the German classification, an energy-efficient house is a house with negligible energy consumption, a building with such a low consumption of thermal energy for heating that a separate heating system becomes unnecessary: the necessary heat can be supplied thanks to the already existing ventilation system. At the same time, the maximum allowable annual specific consumption of thermal energy for heating **the** *building, related to the living area, must be ≤15 kWh / (m ^{2} · year). In Germany, a scale has been developed with which it is convenient to classify buildings according to energy efficiency.*

Heat energy consumption by building type in Germany[31]

Table 11. Heat energy consumption by building type in Germany

Individual residential building with a total area of 140 m 2	***Annual consumption, kW h / m 3 · year***	***Specific heat consumption, kW h / m 2***
old building	*300*	*136*
Typical house from the 1970s	*200*	*91*
Typical house from the 1980s XX century	*150*	*68*
Low energy house in the 1990s	***0–70***	***14–32***
Ultra Low Energy House	*30–15*	*14–7*

[31] https :// ozlib.com /947216/ tehnika/tehnologii_energoeffektivnogo_stroitelstva

Modern "passive" house	***<15***	***<7***

The idea of building "passive houses" is rapidly spreading throughout Europe and gaining popularity. The passive house standard becomes a model for subsequent construction. According to statistics, in Germany, by 1999, 3 thousand "passive buildings" were built, by 2005 - about 5 thousand, and by 2010 there were already more than 7 thousand.

The targeted state programs have been developed and adopted to bring all objects of regular development to a conditionally passive level (ultra-low consumption houses up to 30 kWh / m^3 per year).

Unfortunately, for various reasons, the development of energy-saving technologies in construction began in our country with a significant delay. Today, most buildings in Uzbekistan fall far behind European energy efficiency standards. *Thus, in buildings of old construction, energy consumption reaches 600 kWh /m^3 per year, while the indicators of German buildings built in the 1970–1980 are approximately 300 kWh /m^3 per year, not to mention "passive" homes where the energy standard should be ≤15 kWh/m^3 per year. And the actual average heating consumption (specific heat consumption) in Uzbekistan is on average 320-390 kWh / m^2, while for comparison, in Holland with colder climatic conditions, this figure is 95 kWh /*m^2, *the average Europe - 150 kWh / m^2, and the world average - is about 220 kWh /m^2.*

Buildings currently account for 49% of total energy consumption or 17 million tons in Uzbekistan. (ton of oil equivalent) per year [32]. Accelerated industrialization and stable population growth significantly increase the economy's need for energy resources, as well as increase the negative anthropogenic impact on the environment.

Public buildings consume more electricity than other sectors of the country's economy and in the overall energy balance of Uzbekistan, this figure is about 40%, significantly ahead of industry and the transport sector. The energy saving potential of social buildings, such as educational and medical institutions, exceeds 40%, which is of great importance for reducing greenhouse gas emissions. The reasons for the high energy consumption in the sector of buildings and structures are the non-compliance of their technical characteristics with modern energy efficiency requirements, including the use of inefficient lighting, heating, air conditioning, thermal insulation materials, etc.

Over the past 10–15 years, encouraging shifts have been taking place in this direction in the country. Since 2017, a joint six-year project of the United Nations Development Program (UNDP) in Uzbekistan has been implemented jointly with the Ministry of Construction of the Republic of Uzbekistan with grant support from the Global Environment Facility (GEF) "Assistance in the development of construction of energy-efficient rural housing in Uzbekistan". The main goal of the project is to provide the rural population of Uzbekistan with improved and affordable living conditions that do not harm the environment. About $136.6 million has been allocated for these purposes. A lot of work has been done since the start of the project.

Based on Decree of the President of the Republic of Uzbekistan PP-4028 dated November 24, 2018, a subsidized green mortgage lending scheme was developed to increase demand for energy efficient and low-carbon (LC) rural housing. One-storey and multi-storey EE and HC affordable rural houses were built in five regions of Uzbekistan.

The construction of a demonstration pilot house with almost zero energy consumption has been launched in the Yoshlik mahalla in the city of Nurafshan in the Tashkent region. This project aims to reduce energy consumption in the residential sector by improving the thermal performance of the structures themselves, as well as the introduction of energy efficient and low-carbon technical solutions.

Today, the main priority of the government of Uzbekistan is the widespread introduction of energy-saving technologies and the use of alternative energy sources in the economy, the social sphere and the construction industry. A number of decisions of the Government of the country provide for separate norms in order to radically increase the requirements for energy efficiency of newly built and

[32] https :// www.undp.org/ru/uzbekistan/press-releases/development-prospects-construction-energy-efficient-buildings-in-uzbekistan

reconstructed buildings. These norms regulate, along with the revision of urban planning norms and rules, the development of regulatory documents to determine the energy efficiency classes of buildings and structures, as well as the installation by state bodies and organizations in existing buildings on their balance sheet of small solar photovoltaic stations, solar water heaters, heat pumps, sensor sensors combined with LED sources for lighting systems, etc.

The issue of ensuring the energy efficiency of buildings is becoming increasingly important against the backdrop of climate change, since almost 30% of the total share of greenhouse gas emissions into the environment comes from the construction sector. Since the scale of housing construction in Uzbekistan is growing every year, there is a huge potential to reduce greenhouse gas emissions by ensuring the energy efficiency of buildings under construction through the use of energy efficient and low-carbon materials and technologies.

4.7. Development of tourism and agriculture in the context of the "green economy"

Development of ecological and agricultural tourism areas

Tourism is one of the fastest growing sectors of the global economy today. It reportedly contributes 9% to the global gross domestic product (GDP), provides one out of every 11 jobs in the world and 6% of global exports. According to experts' forecasts, by 2030 the number of international tourists may be about 2 billion people. As a result of the intensive development of tourism and tourist services in recent years, promising types of tourism, such as ecotourism and agrotourism, have begun to gain momentum, especially rapidly in the world.

Ecotourism is the only direction in the tourism industry that is interested in preserving the main resource - the natural environment or its individual components (natural monuments, certain types of animals and plants, natural landscapes, etc.). It provides for environmentally responsible travel, towards undisturbed natural areas, with the aim of exploring and enjoying nature and cultural attractions, which contributes to the protection of nature, has a mild impact on the environment, ensures the active socio-economic participation of local residents and their benefits from this activity. Currently, the goal of ecotourism is the rational use of nature in the tourist direction - to ensure the environmental safety of the future generation and its sustainable development.

Agri-ecotourism is now at the peak of popularity in Europe and, according to some estimates, brings from 10 to 20% of the total income of the tourism industry. Moreover, 35% of the inhabitants of the EU countries prefer to rest in the countryside to any other. At the same time, in many countries, eco-agro-ecotourism is considered as one of the leading directions for the development of the national tourism industry, which is reflected in the national concepts of tourism development.

Tourism in Uzbekistan is recognized as one of the main sectors of the economy, which in recent years before the pandemic has become one of the “growth points” of the national economy. According to the statistics of the World Tourism Organization, at the end of 2019, Uzbekistan was in the top five countries with the fastest growing tourism industry. The tourism potential of the country is huge, in which a rich historical heritage harmoniously coexists with modern architecture and high-tech development. The advantage of the tourism sector of Uzbekistan, as a tourist destination, is due to the natural and cultural heritage, historical and anthropogenic assets, numbering 7.4 thousand cultural heritage sites. In 2019, the contribution of the tourism industry to the republic's GDP amounted to 2.7%. The concept for the development of the tourism sector in the Republic of Uzbekistan for 2019–2025 (hereinafter referred to as the Concept) consolidates the vision and main priorities of the state for the further development of a competitive tourism industry. Through the development of the necessary infrastructure and the successful promotion of the republican tourism potential in world markets for 2021-2025, the goal was to increase the share of tourism in the country's GDP to 5%, and also to attract more than 9 million tourists by the end of 2025, including 2 million people from far abroad. The Decree of the President of our country "On measures to ensure the accelerated development of the tourism industry of the Republic of Uzbekistan" dated December 2, 2016, serves as an important guide in improving the efficiency of work in this direction. The high tourist potential of the republic can also attract solid investments; thus, the infrastructure will also develop. The advantages of the tourism services sector are obvious.

Uzbekistan has broad prospects for the development of ecological tourism, the deployment of a unique and sustainable network of ecotourism routes, attractive to all categories of tourists, with further integration of the republic into the international market for such services. Today, Uzbekistan occupies one of the leading places in Central Asia in popular ecotourism destinations. The development of ecotourism provides for comprehensive support for the environmental protection system, the conservation of biodiversity and unique natural areas, the maintenance of incomes for the local population and is a promising market for investment projects. The only limiting factor is the underdevelopment of tourism infrastructure, the lack of guest houses in remote areas in the proper quantity, as well as sustainable access to energy supply, moreover, based on the use of renewable energy sources.

Also, a number of tax incentives and subsidies have been proposed in the republic in order to develop tourism and infrastructure. From July 1, entrepreneurs who have opened guest houses, food and trade outlets, entertainment venues in tourist villages will pay turnover tax and social tax at a rate of 1% for three years, as well as only 1% of the accrued amount of property tax, land and water taxes.

Loans will be provided to family entrepreneurs:
- up to 50 million soums - for the creation of guest houses in tourist villages;
- up to 300 million soums - for the construction of complexes of yurts and eco-houses;
- up to 300 million soums - for the construction of tent camps.

Since 2022, the practice of covering the internal 20% of the costs of tourist trips of their employees once a year from extra-budgetary funds has been introduced for state organizations. In addition, from September 1 , 2022, for citizens traveling around the country, refund system (cashback) 15% of the cost of air, railway and bus tickets, 20% of the cost of hotel accommodation, 50% of the cost of tickets to museums and other cultural objects.

The Decree of the President of the Republic of Uzbekistan No. UP-5781 dated August 13, 2019 “On measures for the further development of the tourism sector in the Republic of Uzbekistan” proposes measures for the priority and uninterrupted supply of tourist infrastructure with electricity, including with the promotion of the use of alternative energy sources and with taking into account the increase in the tourist flow to the country. At the same time, special attention should be paid to the uninterrupted supply of electricity to entertainment centers, attractions, museums, theaters, cinemas, cultural heritage sites and other objects.

Tourism is an important source of greenhouse gas emissions on a global scale. According to various estimates, tourism currently contributes approximately 5.2–12.5% of all greenhouse gas emissions. All this, in turn, negatively affects, among other things, the prospects for the development of tourism, increasing uncertainty and risks for its development. The development of tourism should be linked in the context of the growth of energy consumption, mainly based on renewable energy sources, both in travel and in transport, in places of residence and in the course of providing tourism services. For tourist eco-objects located along the valleys of small rivers and watercourses, it is advisable to use mini and micro hydroelectric power plants located in close proximity to the objects, potential consumers. This will make it possible to rationally use renewable energy resources and avoid large investments in the construction of expensive power lines and step-down transformer substations. The possibility of efficient use of solar energy is available for tourist facilities located in areas of decentralized energy supply and in settlements that do not have access to electricity. The wind energy potential can be used for tourism facilities in certain regions of the country as autonomous or additional low-capacity energy sources. Mostly in tourist areas and households, low-power stations (microgeneration) are used to generate electrical energy, including small hydropower plants with a capacity of 5 to 30 kW, solar water heating sources, wind farms, which are most often used to meet their own needs. It is expedient and efficient to use microgeneration for lighting, food preparation, water heating , use of communications and mass media (television, radio, computer technology).

Development of the agricultural sector and forest areas in the context of the "green economy"

In 2017, the total greenhouse gas emissions in Uzbekistan amounted to 189.2 million tons of CO_2-eq., and 180.6 million tons of CO_2-eq. taking into account takeovers [33]. The total GHG emission for the period 2010-2017 decreased by 10.9 million tons of CO_2-eq., which is 5.4%. Since 2010, there has been a trend towards a decrease in the contribution to the total emission of the Energy sector (from 87.1% to 76.6%) and an increase in the contribution of the agricultural sector (from 7.4% to 17.2%) due to the growth livestock and the use of nitrogen fertilizers.

Agriculture is one of the leading backbone sectors of the economy of the Republic of Uzbekistan, which forms the agro-food market, food and economic security, as well as the labor potential of rural areas. There are about 100 thousand farms and more than 20 thousand food industry enterprises in the country. The production activity of the enterprises of the industry is quite energy intensive and in their activities these enterprises use up to 30% of the electricity of the republic, and also consume a significant amount of water resources.

Table 12. Emissions and removals of GHGs in agriculture for the period 2010-2017

Category IPCC	2010 Emissions/ GHG absorption (thousand tons of CO_2-eq)	Source share in total emission, %	2017 Emissions/ GHG absorption (thousand tons of CO_2-eq)	Share of sources in total emission, %
internal fermentation	14 306.07	6.1	19446.3	9.3
Direct N_2O emissions from cultivated soils	6479.82	2.8	7948.09	3.8
manure management	2,295.48	1	3,093.82	1.5
Indirect N_2O emissions from cultivated soils	2,116.68	0.9	2565.03	1.2
Indirect N_2O emissions from manure management	323.3	0.1	430.25	0.2
Rice cultivation	163.75	0.1	168.8	0.1
Total by sector	**25,685.09**		**33,652.29**	

During 2000-2017 _ emissions increased 2.1 times, meat production - 2.7 times, milk - 2.8 times. In 2011, in agriculture, the favorable trend of reducing specific emissions was replaced by an unfavorable one (growth in specific emissions). The reasons are the rapid growth of the number of cattle in the absence of proper processing of animal waste. This creates the risk of violating the country's emission reduction commitments compared to 2010.

It is not possible to reduce the technogenic impact on the climate only by reducing the carbon footprint (reducing greenhouse gas emissions, GHGs). Industrial enterprises will still create it, albeit to a lesser extent than now. Help in its zeroing should forests, which in the process of natural photosynthesis absorb carbon dioxide from the atmosphere more efficiently and cheaper than industrial methods of capturing and utilizing it. As you know, 1 hectare of forest belt absorbs about 4 tons of carbon dioxide per year [34]. In many ways, the amount of deposited carbon dioxide (CO_2) depends on the type of tree, geographical and climatic conditions in which it grows. Forests mainly perform ecological (protective, sanitary-hygienic, health-improving and recreational) tasks and socio-economic functions. Forest plantations serve to protect agricultural crops from water and wind erosion, transform flood currents into groundwater, stabilize shifting sands, and combat desertification. The forest fund of the Republic of

[33] https://unfccc.int/sites/default/files/resource/FBURUzru.pdf

[34] https://studbooks.net/999214/ekologiya/rol_zelenyh_nasazhdeniy_ochistke_vozduha_pyli_gaza

Uzbekistan is 12 million hectares, including 3.2 million hectares of area covered with forest. These forests absorb 12.21 million tons of CO_2 (3.82 tons /ha).

Table 13. GHG emissions and removals in forestry and other types of land use for 2010-2017

Category IPCC	2010 Emissions/ GHG absorption (thousand tons of CO_2-eq)	Source share in total emission, %	2017 GHG emissions/removals (thousand tons of CO_2-eq)	Source share in total emission, %
Forests that remain forests	-22147.86	9.4	-12207.72	5.8
Grassland Remaining Grassland	11200.4	4.8	5024.2	2.4
Arable land remaining arable land	-2002.13	0.9	-1448.72	0.7
Total by sector	-12949.59		-8632.24	

By 2030, it is planned to increase the area of forest fund lands to 14 million hectares, of which lands covered with forests - up to 6 million hectares[35]. In this case, the absorption of GHG will be 22.9 million tons. tons CO_2. In order to reduce GHG emissions and decarbonize in the spheres of agriculture and forestry, a number of resolutions and decrees of the President of the Republic of Uzbekistan, other regulatory legal acts have proposed specific measures and activities that contribute to the process of decarbonization and reduce emissions in these sectors.

As part of the FGD, the participants also proposed a number of recommendations that, in their opinion, should contribute to the promotion of decarbonization in the country.

4.8. Training and management of human resources

The training and management of human resources is an important aspect of the development of any organization or government structure. One of the main tasks in the field of personnel training and management is to ensure a high level of professional training for personnel. In Uzbekistan, there is a wide network of educational institutions that provide an opportunity to receive higher and secondary specialized education. State programs also provide funding for scholarships and other forms of support for young professionals. In addition, the country uses a number of training and retraining programs in various fields of activity, including study abroad programs. Research activities and innovations are also important in the training of personnel, which allows increasing the scientific potential of the country and improving the quality of education. An important aspect of personnel management is the development and implementation of professional development and career growth programs for employees, as well as the provision of social guarantees and benefits for employees. For these purposes, an appropriate infrastructure has been created in Uzbekistan, including various funds, social programs and other support mechanisms. In general, numerous activities are being carried out in Uzbekistan aimed at improving the training and management of personnel, which makes it possible to ensure the development of the economy and improve the quality of life of the population.

Ensuring quality education and training on RES. The plans of the government of Uzbekistan to double electricity generation by 2030 with a significant share of energy generated from renewable sources require the involvement of a large number of experts in the field of energy and renewable energy. Doubling the production of electricity will require an increase in generating capacity and modernization of existing ones, the construction of new and modernization of existing electrical distribution networks, and an increase in the share of generating capacities using renewable energy sources. Such large-scale transformations require a large number of highly qualified personnel in the field of production, distribution and delivery, design and construction of power plants using the energy of the sun, wind, earth

[35] Decree of the President of the Republic of Uzbekistan No. PP-4850 dated 06.10.2020

heat (geothermal), natural movement of water flows, biomass, which are naturally restored in the environment.

However, the survey showed that the RES sector is not provided with specialists, the required competence (30%), they are severely lacking, and in some areas, they are completely absent (62%). In this regard, companies in the RES industry attract qualified domestic (32%) and foreign (38%) specialists for design, business planning and construction. At the same time, the level of competence of specialists is insufficient in all authorized state bodies (54%). It is necessary to ensure the launch of secondary specialized education programs (installers, operators, operators, etc.) in colleges, as well as relevant engineers in technical universities, to conduct special training seminars for improving the qualifications of specialists, to stimulate more science in the field of renewable energy, research in this industry. During the survey, it was revealed that the lack of specialists in the provision of services for the use of renewable energy technologies and their maintenance is becoming a barrier to the development of this area. During the FGD, it was revealed that the deterrence of the use of renewable energy is largely due to insufficient awareness of both producers/suppliers and consumers of energy based on renewable energy, its participants confirmed the conclusion based on the results of the survey about the low provision of the renewable energy sector with competent personnel. They noted the need not only to train engineers with higher education, but also specialists of the middle technical level. 52.8% of FGD participants indicated an insufficient level of human resources and low availability of specialists in the field of RES and EE, and 37.7% indicated problems in preparing a feasibility study and planning energy production from RES.

4.9. Experience of innovative energy-efficient green technologies developed by local producers and measures for their wide implementation

State support for innovative projects developed by local business entities. Development of green technologies

Uzbekistan determined the accelerated introduction of modern innovative technologies in all spheres of activity as an important condition for its dynamic development. The main task in this case is the full use of the potential of domestic science and ensuring access to the world market of modern technologies, including through the transfer and commercialization of scientific and technical developments. For these purposes, a special ministry has been created in the country - the Ministry of Innovative Development of the Republic of Uzbekistan. (Under the Decree of the President of the Republic of Uzbekistan No. UP-269 dated December 21, 2022, the Ministry of Higher and Secondary Specialized Education and the Ministry of Innovative Development were reorganized into the Ministry of Higher Education, Science and Innovation). For the first time in the country, a system has been set up to announce competitions for start-up projects, mechanisms for their financing have been introduced, based on support at the initial stage and the readiness of the product to enter the market. The first scientific accelerator in Uzbekistan supporting projects at the initial stage, CAT Science Accelerator, was organized. For the qualitative selection of scientific and innovative projects on a competitive basis, for the first time in the country, new tools for conducting technical and scientific expertise have been introduced.

In accordance with the Decree of the President of the Republic of Uzbekistan No. PP-3855 dated July 14, 2018 “On additional measures to improve the efficiency of commercialization of the results of scientific and scientific and technical activities”, a new system for the commercialization of scientific developments has been created, aimed at ensuring the accelerated implementation of domestic scientific, applied and innovative projects and developments, increasing the contribution of science to strengthening the competitiveness of the country's economy. To select scientific and innovative developments, and attract investors for their commercialization, the Customer-Researcher-Investor portal was launched, in which about 530 developments are registered.

The implementation of the Small Grants Program continues in Uzbekistan. The Global Environment Facility (GEF SGP) and communities can receive up to 50 thousand dollars for the introduction of innovative ideas and green technologies. The GEF SGP has made a great contribution to the dissemination of technologies such as laser leveling of fields to save water and get more crops, biogas, micro waterpower stations, aquaculture, conservation agriculture and others. But many technologies that Uzbekistan really needs are not being widely implemented for various reasons. It is necessary to direct investments in the

creation of digital technologies for the agricultural sector, which will allow farmers to master modern methods of using services and farming, while minimizing the human factor, increasing access to operational reports and forecasts on water availability and the likelihood of adverse weather events, and helping representatives of the agricultural sector to become more independent in the search for green technologies and making decisions on their choice and use.

The republic has technological developments on the use of renewable energy sources and alternative energy sources. Let us consider such examples of energy efficient systems based on RES and energy saving.

Autonomous technical complex based on hybrid sources of electrical energy powered by solar and wind energy in combination with hydrogen technology systems

Recently, with the participation of international organizations, financial institutions, experts and specialists from developed and developing countries, many scientific and practical events dedicated to hydrogen energy carriers have been organized and carried out. It is known that the widespread use of hydrogen in the energy sector "gives humanity a unique chance to survive in a world free from environmental and social disasters", since the combustion of 1 ton of hydrogen releases as much heat as the combustion of 3.5 tons of fossil fuel.

A group of scientists with the participation of specialists developed a technical solution for the rational use of an autonomous technical complex based on hybrid sources of electrical energy powered by solar and wind energy in combination with hydrogen technology systems, which has the following features:

no external energy and communication infrastructure is required;

availability of its own power supply system based on hybrid autonomous technologies (solar and wind energy);

production of hydrogen gas by water electrolysis;

the main raw material is ordinary distilled water obtained from atmospheric air.

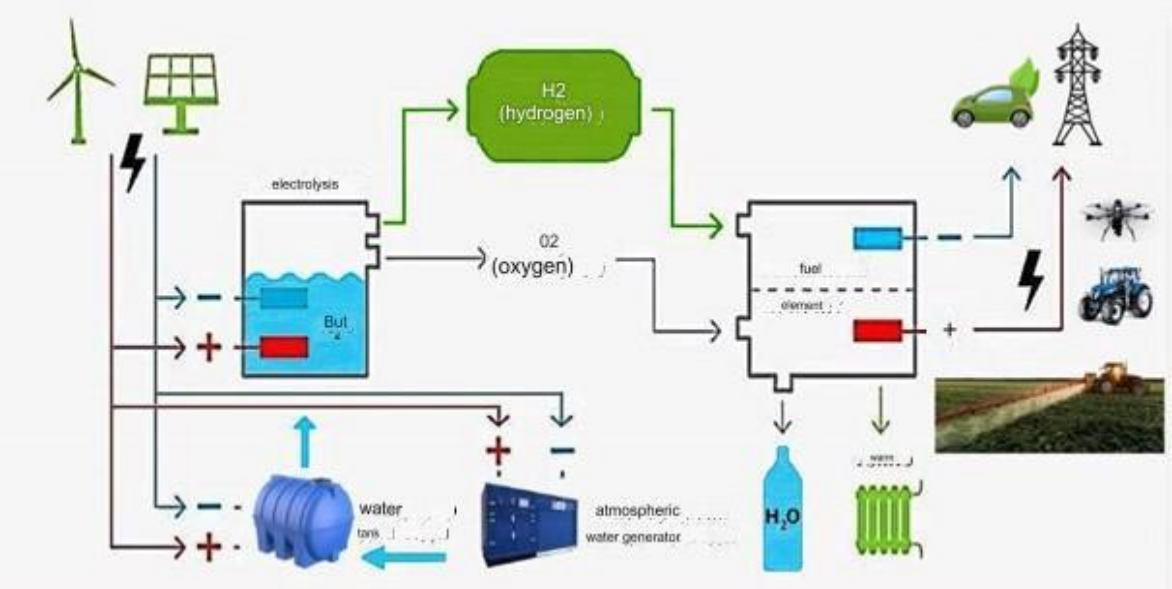


Figure 13. The block diagram of an autonomous technical complex based on hybrid energy sources and a hydrogen system has the form

LLC " ATETM ", General Director, Professor Isaev R.I.

The introduction of solar PV at the enterprise and in the household.

1. Introduction to an enterprise in the city of Tashkent of a network solar PES with an installed capacity of **100** *kWh. The average cost of this turnkey station can be 1,050,000 thousand soums. The electricity tariff for enterprises is 450* **UZS** */ kWh.*

The total annual electricity generation (per year) will be **150,966** *kWh. A network solar power plant will save 67,935 thousand soums per year. This solar power plant will fully pay for itself within 15 years.*

Figure 14. JSC "MAXAM - CHIRCHIQ", Chirchik, solar power plant capacity 100 kW

of a private house in the city of Tashkent of a network solar PES with an installed capacity of **20** *kWh. The average cost of this turnkey station can be 210,000 thousand soums. The tariff for electricity for individuals is 295 UZS / kWh***,** *but if an individual sells electricity from the state PES, then the selling price is 1000 UZS* **/** *kWh.* **The total annual electricity generation** *will be 30,193 kWh. When used for own use, half of the energy received is needed, the annual savings from a network solar power plant will be ~ 4,454 thousand soums. And when selling the surplus of the received energy components to the state, you can get an income of 15,097 thousand soums. The total annual economic effect of the solar PPV will be 19,551 thousand soums. This solar power plant will fully pay for itself within 10.7 years. In the future, bringing real profit to its owner.*

In the case of liberalization of electricity prices, the payback of solar stations will be significantly reduced.

SUN-HIGHTECH LLC, Commercial Director, Dusmatov U.Z.

Introduction of solar water heaters for hot water supply

Solar water heaters are the most common and cost-effective way to use solar energy. Implementation at an enterprise in the city of Tashkent of a solar water heating complex consisting of 5 solar vacuum active collectors and 1 storage tank with a volume of 1000 liters. The cost of this turnkey station can be 42,000 thousand soums. The electricity tariff for enterprises is 450 UZS **/** *kWh.*

The temperature difference, i.e. the difference between the water temperatures at the inlet and outlet of the heat exchange tank is found by the formula Δt = thot - tcold (2) and is Δt = 60–10 = 50 ^{0} C.

Determining the amount of energy for heating water: To heat 1 liter of water by 1 degree, you need to spend energy equal to 1 Kcal, and to heat V liters by Δt degrees, you need to spend Q = V Δt = 1000 50 = 50 000 Kcal. To convert kilocalories to kilowatt-hours, we use the ratio 1 kW **h** *\u003d 859.8 Kcal, therefore Q \u003d 50,000 / 859.8 \u003d 58.153 kW* **h** *.* **Knowing** *the amount of energy needed to heat water 58.153 kWh in* **0.5** *days, we find the annual consumption of 58.153 kWh 365 days / 0.5 =* **42451.69** *kWh.*

Based on these data, we will determine how much we save per year at 1 kW = 450 soums.

42,451.69 kWh **per** *year 450 soums = 19,103.26 thousand soums per year.*

Figure 15. Residential 9-storey building, Tashkent, Mirobad district, Oybek street 42.

This solar water heating complex with fully used hot water will repay within 2.2 years.

Solar City Plus LLC, Director, Ogay I . G.

Flue gas heat recovery plants

Waste gas heat from industrial enterprises is a cheap source of energy, the recycling of which can save up to 30% of traditional energy resources (coal, gas, oil products and electricity) and use it for production purposes, heating housing and communal services, administrative and amenity premises of enterprises, as well as greenhouses. farms. However, with the maximum use of secondary heat waste gases from industrial production, significantly reduces air pollution with emissions of carbon and other harmful substances, including those from existing boiler houses during heat production, while significantly (at least 10 times) reduces the consumption of scarce water resources.

Since 1951, Sredaztsvetmetenergo JSC has been designing, manufacturing and implementing exhaust gas heat recovery units behind metallurgical furnaces and other heat-using units in Central Asia and far abroad, successfully competing with world leaders in the field of thermal power engineering. For example, over the past 5 years, heat recovery plants developed and implemented by Sredaztsvetmetenergo JSC together with Almalyk MMC JSC ***have generated 1 824 million MW of heat, during the production of which in the traditional way (boiler house) about 580 thousand tons*** *would have been additionally burned* ***. coal*** *or* ***4.1 billion m³ of natural gas,*** *as well as emitted into the atmosphere CO_2, CO - 760 million m^3, SO_2 - 100.4 million m^3, NO_2 -402 million m^3. At the same time, when creating waste heat boilers and heat recovery plants, the effect of evaporative cooling of metallurgical units is used instead of water cooling, which makes it possible to reduce water consumption by about 100 times.*

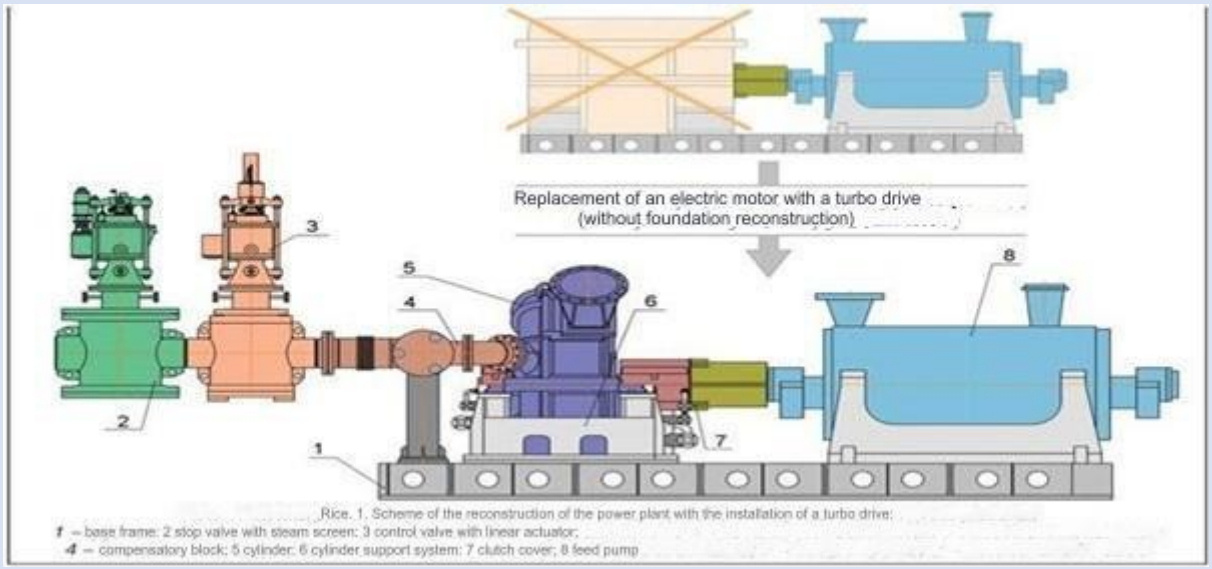


Figure 16. Waste-heat boiler KUKP-10/4 behind a copper-smelting furnace

The use of steam from a waste heat boiler by a steam drive instead of oxyflare melting at Almalyk Metallurgy Company by an electric drive on pumps.

*The economic feasibility **of generating secondary energy resources** and their use, as practice shows, **is 3-5 times cheaper than** the thermal energy generated by boiler houses, and the efficiency of thermal energy in them ranges from 10 to 40%. Heat loss with exhaust gases reaches 65%, with slag up to 30%, and with cooling water up to 12%. A similar situation regarding the use of heat has developed in other industries that use heat (production of building materials, drying and heating in technological processes, etc.)*

JSC "SREDAZTSVETMETENERGO", General Director Kostetsky M.A.

Currently, about 100 biogas plants of various capacities have been built in Uzbekistan. Biogas complex consisting of a bioreactor with a volume of 800 m3 and a gas tank with a volume of 400 m3 was introduced in 2017 in the farm " Baytqurgon - Murotjon FB » Kibray district of Tashkent region, with a loan and grant support from the International Development Association and the trust fund of the Global Environment Facility (GEF).

Figure 17. Biogas complex

This complex processes daily 15 tons of manure from 500 heads of cattle. At the same time, it is produced in the year 1 545 MW of electricity, 1 682 MW of thermal energy and 108 thousand m^3 of commercial biogas, 3 121 tons of bio humus and 7 282 m^3 of liquid biofertilizers, as well as the reduction of annual methane gas emissions by 453.6 thousand m^3, which is equivalent to 836.2 thousand tons of CO_2. With a total cost of expenses for the implementation of this complex equal to 700 thousand USD, the project pays off in 4.5 years.

NGO "Association of Renewable Energy Sources and Alternative Fuels", Deputy Chairman Saipov Z.U.

In the course of the survey, when asked about their readiness to invest in the renewable energy sector, 44% of the total number of respondents answered that they were ready to invest if there were free funds and resources available; 19% expressed their willingness to invest, if there are "cheap and long loans" at an acceptable cost; 13% indicated their willingness in the event of the creation of legal and economic conditions that allow them to extract additional profit. When asked what problems most impede the development of the use of renewable energy sources and the growth of EE, 36.36% of respondents point to weak investment attractiveness and low business activity in introducing

technologies and setting up production in the field of RES and EE. 45.45% each note weak state support and insufficient stimulation of the industry and limited access to information about renewable energy.

It should be noted that in a number of countries of the world the state protects and supports the domestic manufacturer of equipment for renewable energy. For example, in Turkey it is obligatory to use solar collectors, to install two-circuit systems. In Armenia, builders are obligated to use domestic equipment.

Uzbekistan also has appropriate measures to support them. In particular, Uzbekistan prohibits the import of equipment produced in the country. But it is necessary to develop additional measures to stimulate demand for the products of national manufacturers-suppliers of equipment, systems of new energy-efficient technologies and services using renewable energy sources. At the same time, it should be taken into account that the cost of transporting imported raw materials exceeds the cost of the raw materials themselves, which affects the cost of the final product and creates difficulties in selling products. The sales market is also problematic.

4.10. Rational use of water resources. Utilization of organic waste and their processing

Rational use of water resources

Water is a fundamental resource for food production, health protection, a decent life and human development. The world's freshwater resources are under increasing pressure. The problem of water scarcity has become a serious global challenge and has led to the deterioration of the natural environment, a decrease in livelihoods and an increase in the incidence of the population. Today, over 2 billion people in more than 40 countries experience water shortages. Water scarcity in the next 10-20 years may become one of the most acute common problems for the countries of Central Asia. The scarcity of water resources is one of the main limiting factors for the future development of Uzbekistan. Already today, the country is facing problems associated with lack of water, pollution and depletion of water sources. According to forecasts, in the next 50 years, the reduction of river flow in Central Asia will be about 20%, which will complicate the management of water resources in the region, which is already difficult to call well-established and sustainable. At the same time, Uzbekistan is one of the main water users in Central Asia, as the most densely populated country in the region, besides having agriculture based on artificial irrigation. At the same time, agriculture is the largest water user in Uzbekistan. So the possible shortage of water in the future, for Uzbekistan, may become the most acute in the region.

Over the past 50 years, the volume of glaciers has decreased by an average of 30%, and this trend continues [36]. The melting of glaciers has a negative impact on the formation of water resources. An increase in air temperature will lead to an increase in irrigation norms, an increase in dry years, and aridization of the region.

With regard to the provision of water resources, Uzbekistan is in the most unfavorable natural conditions. The hydrographic network of Central Asia has an uneven distribution of water bodies, and of the total available water resources, 20% is formed in Uzbekistan, and 80% is formed on the territory of Tajikistan and Kyrgyzstan. According to the World Resources Institute, Uzbekistan is among the 25 countries most affected by water stress, and water scarcity will worsen with climate change. At the same time, Uzbekistan has one of the highest fresh water withdrawal rates and one of the lowest water use efficiency rates in the world.

The country's agriculture takes up to 90% of the republic's total water consumption, a third of the water in the agricultural sector is simply lost due to the inefficiency of irrigation networks. Water is also inefficiently used in the fields due to aging infrastructure and inefficient agricultural practices. So, at present, 46 billion cubic meters of water is spent on irrigation of 3.2 million hectares of land, of which only 60% reaches the fields. [37]One of the reasons is that only 23% of irrigation networks, the total length of which is 180,000 km, have a concrete coating, and they have not been updated for 30-35 years.

[36] https://unece.org/sites/default/files/2022-10/1.3_Uzbekistan_Batirov%20%281%29.pdf

[37] https://president.uz/ru/2873

The Government of the country attaches great importance to this problem. The following benefits and preferences have been introduced for the development of water-saving technologies[38]:

- *land users are exempt from paying land tax for a period of 5 years.*
- *Suppliers of drip and sprinkler irrigation systems are exempted from paying customs duties and fees.*
- *manufacturers of drip irrigation systems and other water-saving technologies on a preferential basis*
- *By 2025, it is planned to introduce water-saving technologies on 1 million hectares of sown area.*

Thanks to the introduction of water-saving technologies in the Fergana region, it was possible to reduce the cost of farmers for water supply - by 50%, for fertilizers - by 37%, for fuel - by 35%. Experts also call the "green development" of the country a way out of the current situation. FGD participants during the discussion also emphasized the need for rational use of water and proposed a number of recommendations.

Development of a system for the processing and use of organic waste

Today, one of the most urgent environmental problems is municipal solid waste, especially its disposal and processing. According to the analysis, in almost all countries, the amount of municipal solid waste per capita is growing by 1% per year. Due to socio-economic growth in Uzbekistan, the accumulation of waste is growing by 2% per year and the annual volume has reached 9 million tons. In general, none of the 186 landfills across the country meets sanitary and environmental requirements, and 24 landfills are full.[39]

The largest GHG emissions occur at open landfills and landfills. The accumulation of methane in open landfills due to the fermentation of food and other organic waste is a condition for spontaneous combustion of MSW. The relatively low combustion temperature and lack of oxygen lead to the fact that almost the entire table of D.I. Mendeleev flies into the air. Gradually, as a result of corrosion, heavy and non-ferrous metals and other decay products of hazardous chemicals enter the air and water. The composition of the acrid poisonous smoke depends on what is burning.

Table 14. Emissions and removals of GHGs in solid waste and wastewater for 2010-2017

Category IPCC	2010 GHG emissions/removals	Source share in total emission, %	2017 GHG emissions/removals	Source share in total emission, %

[38] Decree of the President of the Republic of Uzbekistan No. PP-4499 of October 25, 2019

[39] https://anhor.uz/ekologiya/musornie-problemi-bolyshogo-goroda/

	(thousand tons of CO_2-eq)		(thousand tons of CO_2-eq)	
Solid Waste Disposal	2282.39	1	2170.97	1
Wastewater treatment and discharge	283.17	0.1	508.53	0.3
Total by sector	2565.56		2679.5	

It is known that landfills are a dangerous source of environmental pollution, therefore, in many developed countries, they try to reduce landfill disposal to a minimum and successfully solve the problem of disposal and processing of solid waste.

Currently, waste recycling is widely practiced in a number of countries around the world. The first steps towards recycling were made in New York in 1895-1898 on the initiative of J. Waring - Commissioner of the Street Cleaning Department. Waste bins of various shapes and colors were installed for household waste. This made it possible to use most of the waste - a special recycling plant was built. Some states have achieved such a degree of recycling that they even buy waste and profit from its use. For example, Sweden recycles 99% of its own waste, in addition, it imports 700 thousand tons of garbage from neighboring countries. China has government programs to support the recycling and disposal of solid waste, and heat and electricity produced from biomass or solid waste are purchased by the state for almost 2 times as much as those produced from conventional fossil fuels.

Uzbekistan also implements a consistent policy in the field of environmental protection, rational use of natural resources, as well as improving the sanitary and ecological condition of the regions. In particular, in 2017-2018, significant work was carried out to improve the infrastructure of the municipal solid waste management system, 13 state unitary enterprises for sanitary cleaning with 174 branches in districts and cities, as well as State Unitary Enterprise "Makhsustrans" and 101 private enterprises for integrated treatment with municipal solid waste. The measures taken made it possible to ensure the coverage of sanitation services for about half of the country's population. In 2019, the Strategy for the Management of Solid Domestic Waste in the Republic of Uzbekistan for the period 2019-2028 was approved, which provides for the implementation of a number of urgent tasks.

In 2021, these enterprises processed 1.1 million tons of waste, which is only 12% of the total mass of waste produced in the country. The problem will be exacerbated by the expected demographic growth. According to experts, by 2028 the volume of municipal solid waste (MSW) will reach 16-16.7 million tons. At present, the accumulation of MSW is a serious problem for the republic: less than 20% of waste is recycled. Unfortunately, there are no food waste processing enterprises in the republic, which make up from 30% to 40% of the total mass, and which carry out the bulk of GHG emissions. For the processing of food and other organic waste, the technology of methane digestion of waste with the production of biogas is of greatest interest to Uzbekistan. In many countries, the production of energy and heat with the help of biogas plants is widespread.

In order to accelerate these issues, the President of the country instructed to increase the coverage of household waste collection services to 95% and the volume of their processing to 40%, and the share of the private sector in this area to 50%. For this, equipment, components and spare parts imported from abroad will be exempted from customs payments for a period of 3 years. For the purchase of sorting and processing equipment, preferential loans for up to 5 years will be allocated to cover a part of the loans that exceeds the refinancing rate. For these purposes, within 5 years, it is planned to allocate 500 billion soums in stages at the expense of concessional funds from international financial institutions. At the same time, land, property and social tax rates for clusters with processing capacities will be set at 1%, and in return, clusters will be required to increase the level of waste processing in their area by at least 40%. And Tashkent instructed the responsible persons to bring the level of waste processing in the capital to at least 50%.

At present, various initiatives are being carried out in the country by foreign financial institutions, including the following recycling initiatives with the participation of the Asian Development Bank:

- *"Solid Waste Management in Tashkent";*
- *"Sustainable Solid Waste Management";*

- *"Recultivation and construction of new solid waste landfills in the Republic of Karakalpakstan and Khorezm region with the participation of the European Bank for Reconstruction and Development";*
- *The project "Generation of electricity by processing waste gas at the Akhangaran landfill" in cooperation with Sejin G&E Co., Ltd (Republic of Korea).*

5. ASSESSMENT OF THE RISKS OF THE IMPLEMENTATION OF THE ROADMAP AND INFORMATION ON TOOLS FOR MINIMIZING THEM

The end of the last century was marked by significant political and macroeconomic transformations, one of the results of which was a global review of the risks and threats facing humanity. In particular, the risks and threats associated with the impact of human activity on the environment on a global scale and, first of all, on the climate, have come to the fore.

The impact of anthropogenic greenhouse gas emissions on the planet's climate system was identified and mathematically modeled in the 1960s and 1970s, and since 1991 has been the subject of a systematic analysis by the Intergovernmental Panel on Climate Change.

The key direction for reducing greenhouse gas emissions is to limit the use of fossil fuels, which currently supply 37 billion tons of CO_2-eq. to the atmosphere. or 2/3 of the total anthropogenic greenhouse gas emissions. Further maintenance of the current growth rates of greenhouse gas emissions associated with the combustion of fossil fuels for energy purposes will lead to an increase in the average global temperature by 4-5°C by the end of the 21st century, which will be detrimental to most existing ecosystems.

adopted at the 22nd Conference of the Parties to the UNFCCC defines three key areas for decarbonization:

(1) mitigation - prevention of global climate change by reducing emissions and increasing absorption of greenhouse gases;

(2) adaptation - prevention of the negative consequences of climate change by increasing the resilience of communities to climate change factors;

(3) reallocation of global financial flows to support adaptation and mitigation measures.

The tools for regulating greenhouse gas emissions are quite diverse, but they can be roughly divided into three groups:

(1) restrictive instruments - taxes, duties, quotas, fines, etc .;

(2) support instruments - subsidies, tax incentives, bonds;

(3) market instruments – voluntary local or international emissions trading systems.

As part of the formation of a national system for regulating greenhouse gas emissions, the greatest attention should be paid to the following aspects:

1. Development of a system for monitoring, reporting and control of greenhouse gas emissions, and its harmonization with international requirements and standards. This also includes the development of a methodological framework for assessing the carbon intensity of products at the industry level, including emission factors for electricity consumption.

2. Development and implementation of flexible financing mechanisms for programs to modernize production and introduce low-carbon technologies aimed at reducing the carbon intensity of production.

3. Development and implementation of a regulatory framework that ensures the implementation of project activities aimed at reducing emissions and/or increasing the absorption capacity of natural greenhouse gas sinks. Using the results of this project activity to offset the carbon intensity of export products.

4. Development of industry-specific low-carbon brands and certification systems for low-carbon products, as well as stimulating the promotion of these products on the European market.

These areas, comprehensively implemented as part of the low-carbon development strategy at the state, industry and corporate levels, will not only minimize the negative effect, but will also become a significant incentive for modernizing production and increasing its efficiency through the introduction of advanced energy-saving technologies and efficient use of resources.

Despite the development of the decarbonization process and the renewable energy market in Uzbekistan, including with the active support of legislation, there are still many difficulties for renewable

energy that limit the growth of the industry. The so-called constraints include legislation, investment risks, spare capacity, non-competitive tariffs, lack of support for microgeneration, and problems of integrating RES into the country's energy system.

Legislative risks. Despite the fact that the contribution of legislation to the development of RES and the timeliness of the measures taken to attract investment in the sector is serious, there is still a need to further improve the legislative framework in the field of RES. The existing legislation, however, is attractive to a wide range of investors. However, the further development of RES and the possibility of a significant contribution to the energy system of Uzbekistan require the improvement of legislation that corresponds to the current stage of development of the industry.

Investment risks. Like any complex infrastructure facilities, RES projects require large capital expenditures at the initial stage of the project. Since most renewable energy projects are financed by loans from international institutions in US dollars, there is a foreign exchange risk for the investor, which can significantly increase the cost of the project in local currency. Significantly limit the development of the industry and other components, such as unfavorable lending conditions in the form of a high rate and collateral requirements, difficulties in connecting to the network and the risk of insolvency of the RES operator.

Non-competitive rates. The current tariffs for RES in comparison with tariffs for traditional electricity make RES uncompetitive without state support. However, the real tariff for traditional energy, which ensures the long-term functioning of the energy system, should be higher. Subject to the functioning of market tariffs, the transition of renewable energy sources to a competitive environment is quite likely. Tariffs need to be increased, but the question is how to increase them, in particular, tariffs should:

- grow for the normal functioning of the system
- be differentiated
- be subsidized for vulnerable populations

During the implementation of this DC, the following risks may arise: behavioral, financial, technical and managerial, regulatory.

The lack of social acceptability for the introduction of renewable energy technologies in various sectors of the economy causes a behavioral risk.

Many of the products and solutions proposed for implementation within the framework of the DC differ from traditionally established practices. As a result, the introduction of new technologies will face the psychological inertia of the technical staff and end users.

The factors influencing the occurrence of this risk are as follows:

- behavioral risk of the society, which is associated with the negative impact of the public position "only not with us" on renewable energy projects

- lack of awareness of the positive effects of the use of renewable energy

- when the community opposes the construction of a renewable energy generation facility close to the place of residence.

- may arise due to an increase in the cost of renewable energy paid by end consumers.

In general, the risks of social acceptability are defined as the risks of refusal to build renewable energy projects by civil society or part of it.

To effectively overcome this barrier, active educational activities are required, as well as the implementation of measures in terms of the “formation” of new values.

The risks that arise from the lack of available capital are financial risks.

Creation of facilities for the production of electricity from RES is a capital-intensive process. Renewable energy projects require the availability of capital, both equity and government funding, in particular subsidies and concessional loans to secure investment. If they are not available, then this can lead to a lack of capital. The main causes of capital shortages are: an underdeveloped or unhealthy local financial sector or a general financial crisis. In addition, limited experience in the implementation of renewable energy projects, combined with higher bank loan rates, may lead to the inability of owners to secure financing for their projects.

The way to reduce this risk is to interact with the executive bodies of state power in terms of using existing sources of financing, including measures for the use of renewable energy in the investment programs of state-owned companies, popularizing and stimulating demand for energy efficiency technologies, creating new financing mechanisms and other forms of state support for business, including with the involvement of development institutions.

Technical and management risks are related to the lack of local knowledge and experience, as well as the degree of maturity of the technology used. Uncertainties arise due to the lack of an adequate assessment of the energy potential of RES resources or the use of new technologies. The potential for loss due to lack of local expertise, inadequate equipment maintenance, and infrastructure constraints are factors that shape technical and management risks.

To minimize these risks, it is proposed:

- to increase the access of the population to information about the benefits and profits of the introduction of RES technology. It is also important and effective to conduct advisory training and workshops on the benefits of introducing RES technology. This approach will significantly reduce behavioral risk.

- to increase the knowledge of the owners of renewable energy technologies in the search for sources of financing from foreign donors, it is also necessary to increase the financial literacy of the population

- promote the training of specialists in the field of installation and maintenance of renewable energy technologies.

The development and adoption of legal acts that regulate actions that have negative financial or other consequences give rise to regulatory risk. The reasons for the difficulties in implementing or even non-compliance with such a bylaw may be its contradictions with other bylaws; lack of benefits in its implementation; lack of funds for implementation; low literacy in decision making; opposite approaches in relation to the institutions of power to the problem and ways to solve it.

Accordingly, changes in existing regulations and standards may meet resistance from regulators and industry players.

To build an effective regulatory risk management process, it is necessary to use internal regulatory documents that regulate this process, which ensure the minimization of regulatory risk for key draft regulations. In order to manage regulatory risk, the authorized body creates a working group. To minimize regulatory risk, a consolidated position is prepared, proposals are recorded, amendments, justifications, and implementation of other measures are recorded. The application of risk management measures means bringing the consolidated position to the interested state structures and coordinating them with the state authorities. The process of internal interaction is organized in the preparation of proposals for creating a comfortable legal environment for doing business, as well as for minimizing the consequences of the identified regulatory risk.

The way to reduce this risk is to work out and demonstrate the effects within the framework of pilot projects, close interaction with regulators, and the involvement of progressive industry players. In addition, it is assumed that an effective mechanism for resolving issues will be the submission of problems to the relevant ministries and departments of the country.

Annex 1

Uzbekistan Decarbonization Roadmap

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
1. Development and improvement of regulatory and legal regulation of the use of renewable energy				
1.	Legal status of renewable energy entities. Improving the regulations for the use of renewable energy	<u>Legal status of renewable energy entities</u> Amend the following laws and bylaws: - Civil Code of the Republic of Uzbekistan - the concept of "energy supply organization" - Law of the Republic of Uzbekistan "On the electric power industry" - the concept of "energy supply organization" - Law of the Republic of Uzbekistan "On the use of renewable energy sources (RES)" - the concept of "energy supply organization"; define the legal status of renewable energy entities as an “energy supply organization” and equate power plants, including microgeneration entities , with energy supply organizations engaged in the generation, distribution and sale of electrical and thermal energy using renewable energy sources.	First half of 2024	Cabinet of Ministers Ministry of Energy Ministry of Justice Chamber of Commerce and Industry Ecological Party of Uzbekistan Association of Renewable Energy Sources and Alternative Fuels
2.	RES microgeneration. Improving the regulations for the use of renewable energy	<u>Micro- and small RES power plants</u> - Amend the Law of the Republic of Uzbekistan "On the use of RES": 1) introduce the concept of "micro-, mini- and small-scale power generation", as well as define the concept of "microgeneration"; 2) determine that small-scale electricity generation should be understood as generating facilities with an installed capacity of up to 50 kW - micro-energy , up to 500 kW - mini-energy, up to 20 MW - small-scale energy, respectively, using the energy of the sun, wind, natural movement of water flows, heat land (geothermal), biogas.	First half of 2024	Cabinet of Ministers Ministry of Energy Ministry of Justice Chamber of Commerce and Industry Ecological Party of Uzbekistan Association of Renewable Energy Sources and Alternative Fuels

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		3) supplement the capacity scale of power plants in the relevant articles of this law using the concept of microgeneration with a capacity of up to 50 kW. 4) determine the conditions that support the functioning of microgeneration. 5) determine that the technological connection of microgeneration facilities can be carried out to electrical facilities of no more than 0.5 kV; - Develop the Rules for the qualification of a generating facility operating on the basis of the use of renewable energy sources. - Study the issue of drafting a Program for the development of microgeneration (development of engineering infrastructure) based on a decentralized model and submit it to the authorized body for consideration		
3.	Decentralized model for the development of the energy sector. Improving the legal framework for the development of a decentralized model of the energy sector (local production and consumption of electricity generated from RES)	- Amend the Law of the Republic of Uzbekistan "On the use of renewable energy sources": 1) define the concept of zones of decentralized energy supply 2) when generating more than 500 kW of electricity in zones of decentralized energy supply, the authorized body for the purchase and sale of electricity to households must build its own local electrical distribution network or must take on the service of the existing local distribution electrical network on a contractual basis. - Develop a procedure for the creation and operation of networks of local production and consumption of electricity (micro, mini and small generation) generated from renewable energy sources (according to a decentralized model of the energy sector) and the involvement of the population (households) in the production and consumption of clean energy.	2023-2024	Cabinet of Ministers Ministry of Energy Ministry of Justice

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		- Develop a procedure for connection (connection) of microgeneration plants using renewable energy sources to general energy networks and a procedure for accounting for sold energy.		
4.	Development and implementation of standards for microgeneration using RES and EE, and relevant regulations and rules	- Study the issue of including indicators of the efficient use of RES in the technical regulations, standards and other technical acts of the Republic of Uzbekistan - Consider the issue of putting into effect technical regulations, standards and other technical acts of the Republic of Uzbekistan that establish the methodological, organizational and technical basis for the effective use of RES, including the microgeneration facilities - Study the issue of including in the technical regulations and standards of the Republic of Uzbekistan energy quality parameters brought in line with international standards recognized by the Republic of Uzbekistan for microgeneration - Develop standards for the use of small generation based on renewable energy sources. - Provide in the "Regulations on the procedure for connecting (connecting) installations for the use of renewable energy sources to the general energy networks" the procedure for certification of micro -generation installations by certified organizations, RES installers, if necessary.	2023-2024	Cabinet of Ministers Ministry of Energy Ministry of Justice Ministry of Investments, industry and Trade Agency for Technical Regulation
5.	Development and adoption of necessary bylaws for the implementation of the law of the Republic of Uzbekistan "On the use of renewable energy"	Recommend the adoption of the following bylaws to implement the law of the Republic of Uzbekistan "On the use of renewable energy sources": - in accordance with Article 6 of the law, develop and adopt a Decree of the Cabinet of Ministers of the country “On approving the procedures for maintaining state accounting of RES resources”,	2023-2024	Cabinet of Ministers Ministry of Energy Ministry of Justice Ministry of Investments, industry and Trade

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		which establishes a rule on open access of interested parties to the data of state accounting of RES resources. - Authorized body in the field of RES: 1) develop the Regulation “On maintaining state accounting of RES resources, energy produced from RES, and RES installations”, which sets out the rules for creating relevant data open and accessible to interested parties (based on Article 7 of the Law); 2) Develop and submit proposals for approval by the Cabinet of Ministers on improving the technical regulations for connecting to the unified energy system electrical energy produced by the population, business entities at social facilities, at low-capacity renewable energy sources (solar, wind and biogas power plants with a capacity of up to 1 MW and hydroelectric power plants with a capacity of up to 5 MW) installed for own needs (based on Article 7 of the Law) ; 3) develop and approve a Standard Sale and Purchase Agreement concluded between a producer of energy from RES and a manufacturer of RES installations and legal entities and individuals for the sale of electrical, thermal energy and (or) biogas produced from RES supplied through a local network (electrical, thermal and (or) gas) (in accordance with Article 11); 4) develop and submit for approval to the Cabinet of Ministers a standard Purchase Agreement signed between the body authorized by the state to exercise the function (authority) of purchasing electricity, and a business entity for guaranteed purchase of electricity produced at solar, wind and biogas power plants with a capacity of up to 1		

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		MW and hydroelectric power plants up to 5 MW (based on Article 13 of the Law) 5) develop and approve for producers of energy from RES and for manufacturers of RES installations "Methodology for separate accounting of energy from RES" (in accordance with Article 12 of the Law); 6) develop and approve the format of the “Reference on the use of renewable energy sources with a complete disconnection from existing energy networks”, issued by an authorized energy supply organization (Article 14 of the Law); 7) develop and approve a standard contract "Connection of consumers of electrical energy to the local electrical network of producers of electrical energy from RES" (in accordance with Article 15); 8) develop and submit for approval by the Cabinet of Ministers the Instruction “On State Accounting for Energy Produced from RES and RES Installations” (based on Article 19 of the Law); 9) develop and approve the "Procedure for granting certification for energy produced from RES and produced by RES installations." (Article 21 of the Law)		
2. Improvement of tariff regulations, measures of tax and customs regulation, and development of financing measures for state support of microgeneration from RES				
6.	Improving the tariff regulations	- For the development of renewable energy in the Republic of Uzbekistan, it is advisable to develop a new tariff policy, taking into account international experience in establishing fixed "green tariffs" for electricity produced by renewable energy facilities, taking into account their capacity and types of renewable energy. - "Green tariffs" for RES energy supplied to the unified energy system should be set at the level	First half of 2024	Ministry of Economy and Finance Ministry of Energy Ministry of Ecology, Environmental Protection and Climate Change Chamber of Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		of the maximum tariff approved in the republic using increasing coefficients depending on the type of RES: - Implement a balanced tariff and pricing policy to cover the actual costs of energy companies for the production, transmission and distribution of electrical and thermal energy. - Provide that electricity generated by renewable energy facilities will be purchased from producers within 20 years after the start of commercial operation at a fixed tariff - Adopt the Decree of the Cabinet of Ministers "On approving the fixed tariffs" for the supply of electricity produced by renewable energy facilities, - Provide indexation of fixed tariffs once every 5 years, taking into account inflation in the price of electricity and the market value of RES equipment.		
7.	Improving the tax and customs regulations	- Introduce benefits (preferences) for local manufacturers of equipment for renewable energy and companies providing relevant services. Ensure that the VAT exemption and other preferences apply only to the volume of production and directly produced goods in the field of renewable energy. - Differentiate the application of the existing preferences issued to the owners of charging stations, depending on the power source used (from the network or from an autonomous station using RES) - Analyze the effectiveness of the established tax and customs benefits in the field of renewable energy, prepare proposals for improving the measures of tax and customs regulation - The authorized state body to consider the issue of VAT exemption for raw materials,	2024	Tax Committee Customs Committee Ministry of Energy Ministry of Justice

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		components and materials used in the field of renewable energy - Conduct an analysis (inventory, monitoring) of the current fiscal system of the state in the field of the use of renewable energy and resource conservation in all sectors of the economy, and determine the effectiveness of the benefits provided		
8.	Development of renewable energy financing measures, including “green financing”	- Intensify work on financing the construction of power plants based on RES using various sources of green financing. - Study the issue of reducing the average interest rate on loans for SMEs in the RES sector EEEE, increasing the size of the loan issued and the period of its repayment, and piloting the introduction of concessional long-term lending with low interest rates for RES facilities - The country's banking sector to strengthen the work on the development of new banking products , contribute to improving the level of financial literacy of SMEs in the RES sectors in the development of business plans for obtaining credit resources, as well as to establish closer cooperation with credit organizations - Seek funding for the creation of a certification service for RES equipment and technologies - Establish an independent Fund for decarbonization and development of RES	By the end of 2024	Central Bank Banking Association Ministry of Economy and Finance
9.	Taking measures to encourage demand for products of national manufacturers - suppliers of equipment, systems of new energy efficient technologies and services using renewable energy sources for the	- Provide state support to national manufacturers-suppliers of equipment, systems of new energy-efficient technologies and services using renewable energy sources, by amending the relevant legal acts - Stimulate financing and allocation of resources for research and development and domestic research work at public and private research institutes at	2023-2024	Ministry of Economy and Finance Ministry of Energy Ministry of Ecology, Environmental Protection and Climate Change Academy of Sciences Chamber of Commerce and Industry

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
	purpose of decarbonization	the expense of the Extrabudgetary Fund of the Ministry of Energy - Develop specialized services for the training of operators and service workers (repair and maintenance), to ensure the provision of engineering services at the stage of business planning, the development of a feasibility study, installation supervision and commissioning, the development of services for designers, builders, installers - Ensure the implementation of the heat gas utilization technology developed by Sredaztsvetmetenergo Joint Stock Company in the relevant sectors of the industry in order to most effectively reduce gas emissions and support national innovations		Association of Renewable Energy Sources and Alternative Fuels
3. Public control and ensuring the effective participation of local communities, civil society, the private sector, the media to control and monitor the implementation of strategic documents on the decarbonization process				
10.	Activation of Public Councils in state authorities, civil society and other stakeholders to monitor and review decarbonization processes	- Consider the possibility of implementing the Decree of the President of the Republic of Uzbekistan "On measures to organize public councils under state bodies" dated July 4, 2018 No. 3837, which provides, among other things, for the mandatory inclusion of representatives of civil society in the composition of Public councils under state bodies, in the context of the process decarbonization - Ensure participation of civil society, business structures, media in monitoring the implementation of all the tasks included in this document in the developed Strategy for decarbonization in Uzbekistan - Adopt an appropriate legal act that ensures the involvement of independent experts from NGOs, research organizations, specialists to conduct an environmental review to study potential sources of environmental pollution - Provide access to civil society activists, stakeholder specialists to	2023-2024	Cabinet of Ministers Ministry of Justice Ministry of Ecology, Environmental Protection and Climate Change Municipalities NGOs Association of Renewable Energy Sources and Alternative Fuels Media

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		information on greenhouse gas emissions in the country - In order to enhance the participation of civil society in the process of decarbonization, create a regional public organization on decarbonization and renewable energy with the participation of representatives of civil society from the Central Asian countries		
4. Awareness of communities, population, civil society and other stakeholders on decarbonization				
11.	Access to Information, public awareness raising and media activism on decarbonization	- Create a decarbonization website at the Association of Renewable Energy Sources and Alternative Fuels, which will be open and accessible for all interested parties to include relevant analytical and academic materials, research and statistics as well as best practices of various countries - Post on open portals the information on results of monitoring the GHG emissions and ensure the popularization of existing portals for the dissemination of information on air quality and GHG emissions - Activate competitions for the best article and study on GHG emissions - Provide civil society, stakeholders with access to information about Greening Plans, forest expansion planting and conservation of vegetation areas as an effective measure for decarbonization - Establish a system to inform the population and promote the benefits of renewable energy in the process of decarbonization of the country - Post special social advertisements on social networks, on television, hold shows, cases, promote best practices for the use of renewable energy - Prepare special television commercials, publish brochures on decarbonization issues, practice public events, public hearings on various aspects of decarbonization	2023-2025	Ministry of Ecology, Environmental Protection and Climate Change Ministry of Energy Agency for Information and Mass Communications National Television and Radio Company Association of Renewable Energy and Alternative Fuels NGOs Local communities

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		- Conduct trainings, round tables, seminars involving specialists, representatives of NGOs, independent experts on decarbonization, the use of renewable energy, EE technologies - At all existing TV channels in Uzbekistan, allocate special airtime to promote various aspects of reducing the GHG emissions, the widespread introduction of energy efficient technologies and the use of renewable energy sources, with the involvement of independent experts, specialists, representatives of civil society - Introduce special headings on the country's decarbonization issues in the media of various levels and various forms of ownership		
5. Measures to mitigate the negative impact of decarbonization on vulnerable populations in the context of the energy transition				
12.	Implementation of social aspects of decarbonization in the context of energy transition	- Ensure the installation of renewable energy equipment for this population (at the rate of one installation unit of a solar photovoltaic power plant with a capacity of up to 3 kW and one unit of a solar water heater with a volume of at least 200 liters for each household) five million vulnerable people in Uzbekistan - Introduce social norms for the population on electricity and gas, and the volume consumed in excess of it should be sold at market prices. At the same time, to establish the size of the social norm for the population for electricity consumption - up to 500 kWh per month - Encourage the development of microgeneration to improve the reliability of energy supply, which will lead to the creation of new jobs, the formation of prerequisites for reducing the consumption of fossil fuels and environmental pollution - Create conditions for obtaining a new specialty for specialists who become unemployed due to the	2024-2025	Ministry of Economy and Finance Ministry of Energy Ministry of Ecology, Environmental Protection and Climate Change Ministry of Construction and Housing Ministry of Employment and Poverty Reduction Chamber of Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		transfer of production to green technologies - Stimulate investment in microgeneration enterprises and provide access to sources of concessional financing - Provide communities with the opportunity to attract investments, including from budgetary sources, including local budgets, to install installations for microgeneration of electricity - Develop public-private partnerships at the local level.		
6. Development of eco-building technologies				
13.	Implementation of energy efficient (EE) and low carbon (LC) building projects based on the use of renewable energy sources and energy saving technologies	Authorized state bodies, when forming master plans of cities and bringing them in line with the goals of decarbonization, should provide for: - a systematic design method, with the involvement of specialists in green building issues - Support green construction of buildings with built-in RES components and the use of energy-saving technologies, incl. modern types of equipment, heat and waterproofing, double-glazed windows, as well as the introduction of the use of canopies and canopies from solar panels into the practice of urban planning. - Improve approaches to architectural and planning solutions in the construction, reconstruction and overhaul of buildings, taking into account energy efficiency and energy saving - a preliminary express energy audit of all state facilities, before installing RES-based power plant equipment, as well as a voluntary independent energy audit of SMEs and other commercial facilities structures - implementation of state programs to improve the energy efficiency of buildings, including the reconstruction of multi-story residential buildings, as well as buildings of individual housing	2024-2025	Ministry of Economy and Finance Ministry of Energy Ministry of Ecology, Environmental Protection and Climate Change Ministry of Construction and Housing Ministry of Transportation Chamber of Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels NGO "Council of Green Building of Uzbekistan"

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		stock - Create a system of energy certification of buildings and the development of a mortgage lending system for energy efficient repairs, in particular, the use of "green" mortgage; - Develop and modernize technologies for the production of engineering equipment, thermal insulation materials, heating and air conditioning systems based on "green" standards; - Expand green and park areas with efficient use of water resources, incl. drip irrigation - Reduce GHG emissions, increase the use of electric cars, bike lanes, electric buses, as well as the introduction of digitalized traffic lights with cameras		
7. Development of tourism and **a**griculture in the context of "green economy"				
14.	Development of eco- and agrotourism areas	- In all ecotourism regions of Uzbekistan, use energy supply based on clean (green) technologies (various types of renewable energy sources, depending on capabilities of areas) - Consider the introduction of green standards and green certification for eco and agrotourism facilities as the most relevant in the context of their development - Create an Ecocenter for biodiversity conservation using RES as a pilot facility for the use of clean technologies in the ecotourism zone (Aral Sea zone) - Expand training of specialists in eco and agrotourism to use clean technologies and renewable energy sources - Raise the ecological culture of the population in eco and agrotourism areas	2024-2025	Ministry of Economy and Finance Ministry of Energy Ministry of Ecology, Environmental Protection and Climate Change Ministry of Culture and Tourism Ministry of Agriculture Ministry of Water Resources Ministry of Higher Education, Science and Innovation Chamber of Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels NGO "Society for the Protection of Biodiversity" Public Association "Agroinnovation"

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
15.	Development of agriculture and forestry in the context of "green economy"	- Expand the introduction of organic farming methods and diversifying crops (expanding plantings of perennial tree plantations and perennial grasses) - Limit planting of fruit trees along highways due to poisoning of their fruits by car exhaust emissions - Restore degraded pastures and introducing mechanisms for sustainable pasture management; take under special control and strictly suppress violations of livestock grazing in prohibited and protected areas - Consider one of the important tasks of the decarbonization process is the expansion of planting areas of green spaces, as the main factor in absorbing GHGs - Ensure openness and accessibility of the implementation of state programs and forest planting plans for the population and stakeholders parties in order to enable them to monitor the implementation of plans and programs - Create conditions for monitoring planted plants at the bottom of the dried-up areas of the Aral Sea by specially formed commissions with the participation of the population and stakeholders - Optimize the use of mineral fertilizers and chemicals in agriculture and forestry with a predominance of use of organic fertilizers - Install new and modernize existing pumping stations using energy efficient technologies and RES - Restore forests, wetlands and preservation of natural vegetation in all natural zones of the country, as well as increasing the area of forests in mountainous, foothill and desert zones of the country - Use clean technologies in forestry based on modern high-performance energy-saving technologies and RES	2024-2025	Ministry of Economy and Finance Ministry of Energy Ministry of Ecology, Environmental Protection and Climate Change Ministry of Agriculture Ministry of Water Resources Ministry of Digital Technologies Academy of Sciences Chamber of Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels Public Association "Agroinnovation"

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		- Create electronic maps of forest plantations with soil analysis and digitalization in the field of forest plantations, ensuring transparency and reliability of data - Activate regional cooperation in the Aral Sea zone on decarbonization issues		
8. Training and Human Resources Management				
16.	Providing the high-quality education and training on energy saving, decarbonization and renewable energy	- Develop training programs on energy saving, renewable energy and decarbonization for universities and colleges of the republic - Ensure the development and launch of training programs for secondary specialized education (installers, operators, operators and other renewable energy equipment) in colleges, as well as relevant engineering specialties in energy saving and renewable energy in universities - Develop and implement special training courses and programs on environmental protection, environmental protection measures and GHG emissions, on the benefits of renewable energy in educational institutions of all levels of education - Focus on the training of personnel for the development of a feasibility study for RES power generation stations, as well as specialists in their maintenance, especially in remote rural regions - Study the issue of financial incentives on a higher scale of payment for specialists in the field of renewable energy - Expand the number of universities with basic training centers for training specialists in the field of renewable energy - Train specialists on renewable energy issues, create Centers for training, advanced training and consulting, using foreign experience - Intensify the activities of existing centers for training and retraining	2023-2024	Ministry of Higher Education, Science and Innovation Ministry of Employment and Poverty Reduction Ministry of Ecology, Environmental Protection and Climate Change Ministry of Energy Municipalities Local communities NGOs

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		of personnel on energy saving, renewable energy and decarbonization - In secondary educational institutions (schools), develop and implement appropriate training programs, courses to familiarize students with the global nature of energy consumption problems, their impact on environmental pollution, the benefits of energy saving and renewable energy sources, their effectiveness depending on the region		
9. Experience of innovative energy-efficient green technologies developed by local producers and measures for their wide implementation				
17.	State support for innovative projects developed by local business entities. Development of green technologies	- Provide state support to local inventors and entrepreneurs who develop and implement innovative energy-efficient and energy-saving technologies. - Conduct an annual national competition for the development and implementation of innovative energy-efficient and energy-saving technologies - Create a scientific and technical expert council on energy and alternative energy under the Ministry of Higher Education, Science and Innovation - Organize competitions for innovative projects and start-up projects on a regular basis implementation of decarbonization and RES processes - At various facilities in Uzbekistan, implement pilot projects for the introduction of energy-saving technologies and RES developed by local business entities - Implement an autonomous technical complex based on hybrid sources of electrical energy powered by solar and wind energy in combination with hydrogen systems technologies - Expand state support for scientific developments on the use of renewable energy sources in the nature management sector and agricultural production - Through digitalization in the field	2024-2025	Ministry of Economy and Finance Ministry of Energy Ministry of Higher Education, Science and Innovation Ministry of Digital Technologies Forestry Agency Intellectual Property Agency Academy of Sciences Chamber of Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels Society of Inventors and Innovators Media

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		of forest plantations, ensure a complete transition to a digital format for collecting and presenting data on areas of forest areas - Organize annual competitions for projects to reduce emissions and decarbonize, use green technologies and RES in the agricultural sector of the country - Provide state support for scientific developments on the use of RES in the agriculture and forestry sector - Localize the production of equipment for generating energy from renewable energy sources and state support for local inventors and entrepreneurs - Develop a state program for the introduction of solar systems for generating electrical and thermal energy in rural areas and remote regions of the republic; - Create and support demonstration centers for the use of renewable energy sources - Increase the energy efficiency of enterprises through the reuse of heat in industry - Determine the need to replace traditional sources of energy (heat) with non-traditional ones for municipal and agricultural purposes (greenhouses) in cooperation with industrial enterprises that can supply secondary (utilized) heat		
10. Rational use of water resources. Organic waste recycling and processing				
18.	Rational use of water resources	- Increase the efficiency of water use and prevent further salinization and deterioration of land quality - Apply widely renewable energy, energy-efficient, energy-saving and water-saving technologies for irrigating crops, improve mechanisms for stimulating water conservation - Develop criteria for assessing the levels of pollution of water bodies, classifying water bodies according	2024-2025	Ministry of Economy and Finance Ministry of Ecology, Environmental Protection and Climate Change Ministry of Agriculture Ministry of Water Resources Municipalities Chamber of

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		to the degree of pollution and a mechanism for sustainable management of water resources - Develop regulations and methodological documents for the protection of water resources and improvement of the quality of drinking water - When treating wastewater, more widely use biogas technologies, special microorganisms, reducing the use of chemicals - Use efficient technologies and renewable energy sources to economically use water and electricity - Increase responsibility enterprises and organizations for the irrational use of water resources and pollution of wastewater - Limit the use of water in industry for cooling units (with the transition to evaporative cooling), which will save water and use secondary heat - Apply water-saving irrigation technologies, including drip irrigation on slightly saline soils - Implement technologies for year-round regulation of the salt regime of irrigated soils using agrotechnological methods and ameliorants		Commerce and Industry Association of Renewable Energy Sources and Alternative Fuels
19.	Development of a system for organic waste processing and use	- Expand the practice of separate waste collection in terms of separating organic waste from other types using several containers - Develop a procedure for setting greenhouse gas emission standards from organic waste and develop a methodology for calculating waste, bring them to the attention of stakeholders - When designing the construction of organic waste processing plants, take into account volumes of waste generation in the regions of construction - Introduction of biogas and other efficient technologies for the disposal of	2024 -2025	Ministry of Economy and Finance Ministry of Ecology, Environmental Protection and Climate Change Ministry of Agriculture Ministry of Water Resources Ministry of Construction and Housing Municipalities Chamber of Commerce and Industry Association of

No.	Activity	Implementation Mechanism	Timelines	Entity in Charge
		organic waste and their processing - Strengthen the responsibility of authorized authorities for violation of environmental measures and non-compliance with relevant legislation		Renewable Energy Sources and Alternative Fuels

Background on EGED Program

In March 2023, in Uzbekistan, under the projects Effective Governance for Economic Development (EGED) and Promoting energy efficiency and renewable energy production in the community-based tourism sector in Central Asia (Set to SWITCH), the Decarbonization Policy Dialogue Group (PDG) was established and started to work. PDG included civil society actors, experts and business representatives engaged in promoting the innovative green energy and green economy technologies. The main task of the group was to develop a Roadmap for the decarbonization process in Uzbekistan.

The roadmap is a communication tool and consolidates the opinions of various participants and stakeholders, including representatives of civil society and business, on the decarbonization process. The Decarbonization Roadmap for Uzbekistan is a comprehensive strategy and action plan developed on the basis of an analysis of the situation in the country in the field of decarbonization in the context of the energy transition (use of RES). It highlights the current obstacles and gaps in the implementation of government reforms and offers recommendations and solutions to overcome them. The value of this document lies in the fact that the document was developed with the participation of representatives of civil society and the business community, which is a rare occurrence in the development of such documents.

The work of PDG to develop a Roadmap is funded by the UK Government under the Effective Governance for Economic Development (EGED) Program implemented by Acted in cooperation with the World Bank. The NGO Association of Renewable Energy Sources and Alternative Fuels acted as a partner of the program.

EGED Program provides support for improving the effectiveness, accountability and transparency of economic policy reforms in Uzbekistan, Kyrgyzstan and Tajikistan. In close cooperation with the World Bank, Acted Uzbekistan is implementing EGED Program Pillar 2: Civil Society for Accountability to build the capacity of civil society and ensure its active participation in the process of decarbonization in Uzbekistan.

In 2021, as part of the SET to SWITCH Project, funded under the Programme of the EU SWITCH-Asia, ACTED in partnership with BizExpert, conducted a business environment analysis of the renewable energy sources and energy efficiency (RES/EE) sector in Uzbekistan to identify specific gaps in legislation and policy dialogue. The business environment analysis was conducted through consultations with key stakeholders, including relevant ministries, MSMEs, CSOs, business associations, legal advisors, and in the RES/EE sector. The main focus of the SET to SWITCH Project is to develop sustainable tourism, and the objective is to contribute to reduction of the carbon footprint in community-based tourism sector in Central Asia, particularly, in Uzbekistan, Kyrgyzstan and Tajikistan. In March-May 2023, the SET to SWITCH Project and EGED Programme worked together to develop this Roadmap for Uzbekistan.

Methods and approaches applied by the Decarbonization Policy Dialogue Group in data analysis and drafting the Roadmap

As part of the work of PDG, with the support of consultant Musaeva R. G., experts from the Association of Renewable Energy Sources and Alternative Fuels Saipov Z.U. and Khamidova R.A., through desk research, studied the current situation related to decarbonization in Uzbekistan and the implementation of recent government reforms in this area, and prepared an Express Review. Uzbekistan Decarbonization Roadmap has been drafted based on this Express Review.

To identify regulatory problems arising from the policies being implemented, the legal regulation of relations (legislation), the following methods were used: sociological research (survey and questioning), holding a focus group discussion and training seminars with members of the EHD and other representatives of stakeholders on researched issue.

The study was carried out with elements of the RIA methodology based on assessing the availability of the main factors of production (economic resources), assessing the impact of policies (program documents) on development, and reviewing the regulatory framework, which made it possible to separate sectoral environmental problems from policy gaps and identify problematic areas of regulatory legislation. On this basis, tasks and ways to solve them were identified, evidence-based measures were developed to support government reforms in the field of reducing carbon dioxide emissions and expanding the introduction of renewable energy sources (RES) in Uzbekistan.

As a result of multilateral discussions, during training seminars, FGDs and the results of the survey, the Decarbonization Expert Group developed recommendations to eliminate the identified problems and implement effective measures to improve the current efforts of the state in the development of green technologies and reduce carbon dioxide emissions. These recommendations are included in the prepared Roadmap.

The Roadmap provides a brief description (quick review) of the implementation scope of the roadmap, climate change issues and global decarbonization development trends and GHG emission reductions, an overview of current government policy and the development of the decarbonization process in the context of the energy transition, the state of the energy sector, including, small power generation, the use of renewable energy sources and EE growth opportunities in Uzbekistan. The Paper presents assessments of the legal, institutional and policy frameworks in the context of renewable energy production and consumption and EE enhancement, identifies policy gaps and environmental issues, and develops recommendations containing measures to overcome them and support government reforms to reduce carbon emissions. gas and introduction of renewable energy sources in Uzbekistan.

Assessment and analysis of environmental problems, identification of gaps and problems in the use of RES and EE in order to reduce GHG emissions

When preparing the Roadmap for Decarbonization, following the requirements of the Regulatory Impact Analysis (RIA) methodology, an analysis of environmental problems was carried out, failures and gaps were identified in the sector under study. This analysis was carried out considering the generalization of the opinions of PDG members and other interested people, through their survey and questionnaire and focus group discussions (FGD).

The main task of the survey and the FGD was to identify the problems and the current situation of the business environment, production and use of RES/EE by the target group (PDG members). In total, 20 people, PDG members, as well as other interested people, took part in the FGD.

For the survey, two questionnaires No. 1 and No. 2 were prepared in the following areas:

- Questionnaire 1 - on the assessment of environmental problems, reducing greenhouse gas emissions, using renewable energy sources and improving energy efficiency in Uzbekistan;
- Questionnaire 2 - assessing the issues of legal support, policies being implemented and state regulation of the decarbonization process through the use of renewable energy and EE.

According to the field of activity, the respondents who participated in the FGD and answered the questions of the first and second questionnaires were presented as follows:

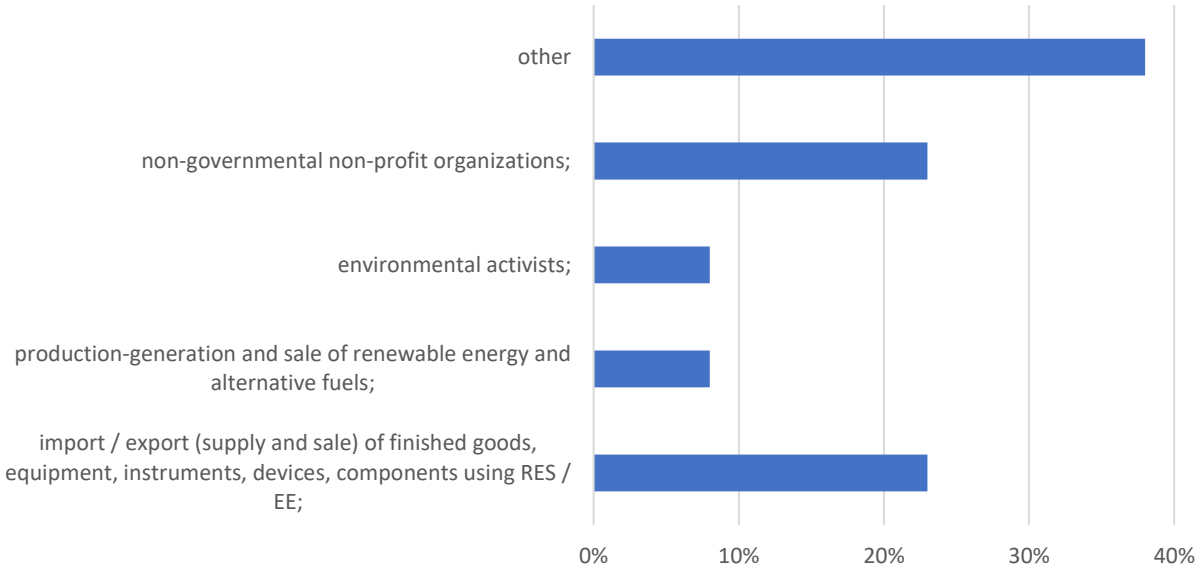


Figure 18. Distribution of respondents by type of activity

The first review activity was the FGD, which was organized as part of the first training workshop for PDG members. As a result of the discussion during the FGD, the participants expressed various problems, facts, processes and gaps, as well as relevant recommendations and, from their point of view, necessary actions in the context of supporting and developing the decarbonization process in the country. All these problems, proposals and recommendations were recorded in the protocol of the FGD, and from them a List was formulated, consisting of 105 problems and proposals.

Summarizing the results of the FGD made it possible to identify gaps and shortcomings in the regulatory framework and implemented policies of the Republic of Uzbekistan in the field of generation and consumption of energy based on renewable energy sources, the waste processing system, water use, control over the implementation of decisions made, in a systematic approach to urban planning issues using renewable energy sources.

It was also revealed that there are key problems and gaps hindering the development of entrepreneurial initiatives, such as the limited access of SMEs to resources such as information, finance, labor, and technology. It was noted that the level of business literacy of the population on the organization of entrepreneurial activities in the field of the use of RES, on the benefits from the growth of EE is insufficient.

Most FGD participants emphasized the low level of legal awareness, technical and financial literacy, that the main barriers to the growth of the use of renewable energy by business entities and private businesses are the high cost and lack of own funds for the design, installation, purchase of renewable energy equipment, materials, energy efficiency technologies. A number of questions related to problems taking into account new green spaces, scientific developments in the field of forestry and agriculture, proposals were made to establish preferences and benefits for the use of microgeneration facilities from renewable energy sources, etc.

Further, all 105 questions and proposals were grouped by relevant sectors of the industry or areas of activity and summarized in one table. Thus, 14 main sectors and areas of activity were formed, in which the relevant questions and proposals were included. The result of this stage of work on the example of one of the identified areas of activity is given below:

Main sectors and activities

Water resource management regulations

- pay additional attention to the development of private business in the field of ownership, operation, maintenance, monetization of wastewater and all types of waste;

- universally introduce the practice of adding hydrogel when planting plants and trees in urban areas and in agriculture, which will reduce the cost of irrigation, both water resources and energy carriers up to 15 times;

- when treating wastewater, it is necessary to use more special microorganisms and less chemicals;

- installation and operation of pumping stations, the use of efficient technologies for the economical use of water;

- efficient use of water resources, careful attitude to them, water conservation, as well as access to water.

Total - 5

For each of the identified areas, percentage indicators were determined by the ratio of questions and proposals included in them to their total number (105). Those. determined the measure of their sensitivity and entered in the table according to the ranking of the received%.

Main sectors and activities	Total
Laws, regulations, standards	13.7%
Information, propaganda and advertising	12.7%
Control and supervision, public control	10.8%
Implementation and construction experience, green renewable energy technologies and energy saving	10.8%
Agriculture and forestry, creation of green areas, tree planting	9.8%
Waste system and recycling	6.9%
Urban planning regulation	6.9%
Labor resources (personnel)	6.9%
Prices and tariffs, pricing, preferences, financing	5.9%
Water use regulation	4.9%
Ecology, Tourism - transition to a "green economy"	4.9%
Institutional reform	2.9%
Technology and Entrepreneurship	1.95%
Science, scientific developments	0.98%
Total selected from 105 proposals	102

If we take 5 points (or approximately 5%) as a sensitive criterion for selecting directions, then we will have 11 out of 14 identified directions, which will be further considered as the main directions for inclusion in the Roadmap.

Next, we corrected the wording of the selected areas, which are brought into line with the laws and legal acts in terms of regulating the analyzed relations, see the table below:

Formed following FGD results	Corrected wording
Legislative regulation, regulations, standards	Development and improvement of legal regulation
Information, propaganda and advertising	Awareness of communities and stakeholders
Tariffs, pricing, preferences, financing	Improvement of tariff regulation, measures of tax and customs regulation and development of financing measures for state support of microgeneration from RES

Similar work was carried out on the basis of the results of the survey-questionnaire. All assessments and responses for each questionnaire were summarized, and relevant information was prepared based on the results of the questionnaire, which were presented to PDG members for discussion.

In general, the conducted legal analysis and the results of the Survey made it possible to identify gaps and shortcomings in the regulatory framework and implemented policies of the Republic of Uzbekistan in the field of energy generation and consumption based on renewable energy sources. It was revealed that there are key problems and gaps that hinder the development of entrepreneurial initiatives related to the limited access of SMEs to resources such as land, finance, labor, information, and technology.

Rice. 11. Explored resources

Land – *main source that predetermines the development of entrepreneurship*	**Capital –** *Basic resource for development and growth*
Information – *is the most important special resource for making the right decision, improve its quality and relevance. Insufficient information results in market failure***.**	**Labor competency** – *the lack of mid-level specialists as well as working specialists in any energy sector, moreover at remote areas (mountains, regions) are deterrent to ensuring the design and operation of RE facilities. The measures implemented by the state is insufficient.*
Ecology – *factor growth, use of RES and EE.* *Reasonable balance between regulatory costs, prohibition on hydrocarbons and use of natural resources RES (water surface flows of small rivers, tributaries, irrigation canals, discharge structures, including hydroelectric power plants, geothermal waters, and limited natural resources e.g earth.*	**Technology** – *availability of technology, choice solutions that bring of technical benefits and social utility, profitability allow you to extract additional profit from the introduction of technologies.*

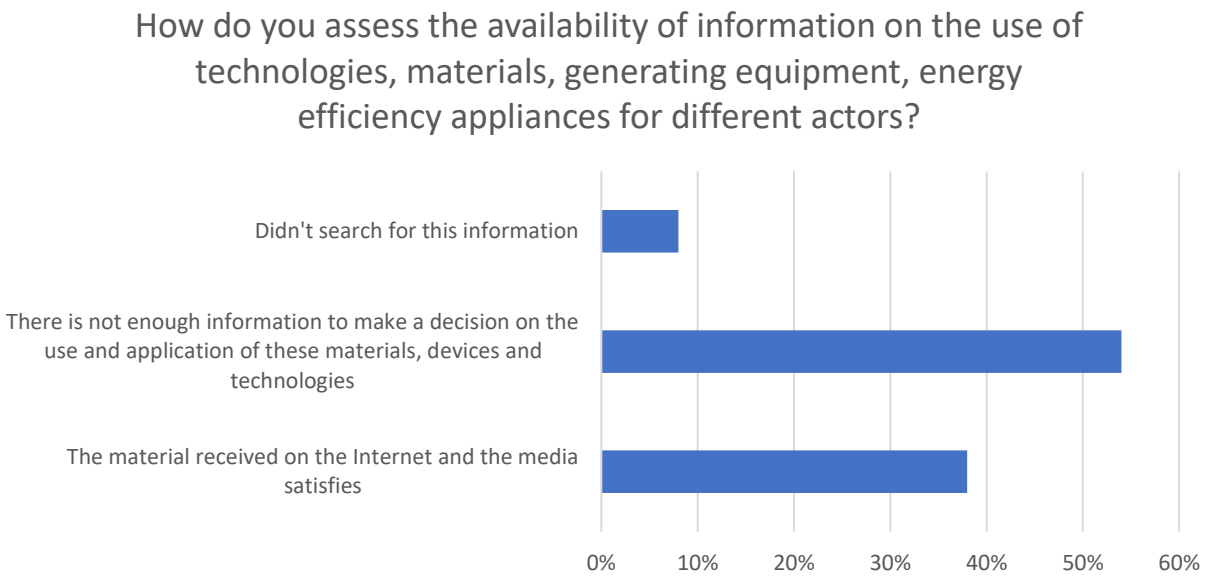
Let us give as an example the results of a survey on the Information factor.

Information is the most important special resource for making the right decision and improving its quality and adequacy. Insufficient information, both technical and legal, and political, and financial, and environmental, or its absence is equated to a market failure.

According to the results of the Survey, it was noted that in the country, access to information on the use of renewable energy and EE is limited, and it is not enough even for a selected category of respondents with high potential.

This refers to insufficient awareness of by-laws, especially those that are not publicly available (the survey showed that 90% of respondents are not aware of by-laws that are not available). There is no adequate and complete information about existing technologies and generating equipment, devices that provide energy efficiency (even those that are already produced in the country today). Limited access to the necessary data for the preparation of a feasibility study, the development of pricing policy and preferences was noted (more than 27% of respondents confirmed their ignorance of tax and other benefits provided for by the Law of the Republic of Tajikistan “On the use of renewable energy sources”).

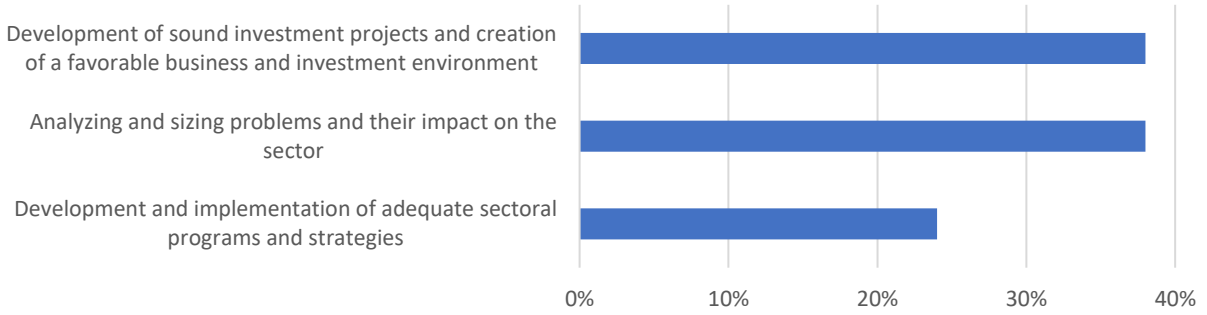
To the question “How do you assess the availability of information on the use of technologies, materials, generating equipment, energy efficiency devices for various subjects?” the following scores were obtained:



Rice. 12. Answers to the question on the factor Information

There are more than enough materials both on the net and in books. The problem is in the experimental substantiation of the expediency and profitability of the application.

The lack of reliable statistics and research results on the use and state of the business environment in the supply of materials, generating equipment, devices that reduce emissions, increase EE and use RES by business entities reduce the quality of:



Rice. 13. Answers to the question of the impact of the lack of reliable information

And as a result, to the question “Is it necessary to conduct propaganda campaigns and place special training materials, online calculators for calculating benefits, costs, costs, independent safe operation of power plants?” 100% of respondents answered in the affirmative

On other questions of the survey, in particular, it is noted that RES equipment is technically complex devices, and the representatives of the owners of the stations lack the skills to maintain and operate them. In addition, they confirm their low awareness of the benefits of using RES/EE.

In the context of the Environmental factor, the question “How do the environmental requirements of the legislation on the use of RES and EE affect the development of your business?” opinions were shared as follows:

1. Give advantages and bring additional benefits - 53%

2. They oblige entities to bear the costs of complying with environmental requirements to preserve the environment and reduce their carbon footprint - 47%.

When listing regulators that create unreasonably high administrative barriers, 50% of respondents who answered this question indicated the following:

- Local governments (district and city khokimiyats).
- Almost all government agencies! The reason is bureaucracy and unskilled staff.

- Setting tariffs.
- And the other 50% indicated that:
- It seems to me that there are no administrative barriers.
- There are no barriers, rather misunderstanding.
- There are no administrative barriers.

The respondents' opinion on the Labor factor (human resources and competencies) was important. It should be of concern that the assessment of 62% of respondents on the state of provision of the renewable energy sector and the growth of EE by specialists with the necessary competencies noted that “There are not enough specialists, and in certain areas there are none at all” and indicated these areas (on the installation and installation of solar panels there are not enough specialists, only a few specialists in wind generation, as well as in heat engineering, adjustment of solar panel equipment, production and use of biogas), 30% agreed with the assessment that the level of training does not meet the required competencies, and only 8% rated this issue as "Satisfactory".

Taking into account the fact that most of the respondents in Questionnaire 2 represented NGOs, researchers and practitioners directly involved in the development of renewable energy and energy efficiency, their answers to knowledge of the current laws and codes of the Republic of Uzbekistan in the context of energy supply and energy efficiency growth were positive, while 63 .64% of respondents noted knowledge of the Law of the Republic of Uzbekistan "On the use of renewable energy sources", and 45.45% of respondents, respectively, noted knowledge of the Law of the Republic of Uzbekistan "On the rational use of energy", Resolution of the President of the Republic of Uzbekistan No. PP-4422 "On accelerated measures to improve the energy efficiency of sectors of the economy and social sphere, the introduction of energy-saving technologies and the development of renewable energy sources”, Decree of the President of the Republic of Uzbekistan No. PP-4477 dated 04.10.19 “On approval of the strategy for the transition of the Republic of Uzbekistan to a “green” economy for the period 2019-2030” and Decree of the President of the Republic of Uzbekistan No. PP-57 dated February 16, 2023 "On measures to accelerate the introduction of renewable energy sources and energy-saving technologies in 2023". However, more than 90% of respondents do not know and do not use in their work by-laws regulating the use of renewable energy and EE.

To the question “Do you know what tax and other benefits are provided for by the Law of the Republic of Uzbekistan “On the use of renewable energy sources” and resolutions of the President of the Republic of Uzbekistan? List them”, the following answers were given:

- 27.27% of respondents answered: I don't know

- 36.36% of respondents answered: Law of the Republic of Uzbekistan "On RES", dated May 21, 2019 No. ZRU-539

- 45.45% of respondents answered: Decree of the President of the Republic of Uzbekistan No. PP-57 dated February 16, 23 "On measures to accelerate the introduction of renewable energy sources and energy-saving technologies in 2023"

- 54.55% of respondents answered: Energy producers from renewable energy sources are exempted from paying property tax for installations of renewable energy sources and land tax on sites occupied by these installations (with a nominal capacity of 0.1 MW or more), for a period of ten years from the moment they enter service.

- 54.55% of respondents answered: Personal property tax is not levied on property owned by persons using renewable energy sources in residential premises with a complete disconnection from existing energy networks for a period of three years starting from the month of using renewable energy sources.

- 54.55% of respondents answered that persons using renewable energy sources in residential premises with a complete disconnection from existing energy networks are exempted from land tax for a period of three years starting from the month of using renewable energy sources.

- 18.18% of respondents answered: from March 1, 2023, when connecting installations of renewable energy sources to electric networks that do not exceed the capacity specified in the technical conditions issued for connection to the unified electric power system, no additional technical conditions are

required. as well as with tax and other benefits provided by the Law of the Republic of Uzbekistan “On the use of renewable energy sources”.

The majority of respondents responded to the question of which imported goods for the use of RES and EE should be exempted from VAT, and gave the following comments:

- micro hydroelectric power station, components and spare parts for RES;
- all types of renewable energy technologies related to solar energy;
- solar systems, namely: modules, batteries, inverters, pumps, collectors;
- household goods using photovoltaics;
- solar stations/panels and their components;
- solar collectors and heat pumps;
- wind stations, wind generators as a set and its spare parts;
- accumulator batteries and their spare parts, collectors, hydrogenators, turbogenerators;
- biomass preparation plants.

To save heat and save electricity, most respondents use modern and traditional finishing and building materials.

Most believe that the main barriers to the growth of the use of RES are their high cost and lack of own funds for design, installation, purchase of equipment, RES, materials, EE technologies, technical complexity of RES equipment, lack of skills in their maintenance and operation by the plant owner’s personnel. In addition, the majority confirm their low awareness of the benefits from the use of RES/EE.

It is interesting that when answering the question about the factors of regulatory problems that most hinder the development of renewable energy sources and the growth of EE, the majority (45.45%) indicated the difficulty of obtaining permits for the placement of generating facilities on land and plots of facilities, although this problem was not mentioned in the FGD, and 36.36% of respondents answered: “Tariff regulation and the manifestation of monopolism”, also 36.36% of respondents indicated the lack of incentive measures to reduce the tax burden and payments before starting operations and generating income.”

As in the first and in the second questionnaire, almost all respondents responded to the question of the need to improve educational work among the population on the legal issues of using renewable energy sources and reducing emissions. Thus, 54.55% of respondents indicated the use of the media in this aspect, and 72.72% of respondents noted the need to organize this work directly in mahallas and villages, providing grants with the participation of public organizations, which must first be trained in the relevant courses at the newly planned to create a Center for Certification, Standardization, Training for the RES Sector under the Uzbek Agency for Technical Regulation, and only 9.09% of respondents answered that it is necessary to stimulate science and education in this area with grants, subsidies and concessional loans. Establish competitions for the “Best scientific, educational and television program work”, etc.

As a result of summarizing the results of the FGD and a survey of PDG members, the work on identifying problems was completed, the following priority areas of regulated relations were finally formulated:

Development and improvement of legal regulation

Improvement of tariff regulation, measures of tax and customs regulation, and development of financing measures for state support of microgeneration from renewable energy sources

Public control and ensuring the effective participation of local communities, civil society, the private sector, the media to control and monitor the implementation of strategic documents on the decarbonization process.

Awareness of communities, the population of the country, civil society and other stakeholders on decarbonization issues

Development of eco-construction technologies

Development of tourism in the context of "green economy"

Training and management of human resources

Experience of innovative energy efficient technologies developed by local manufacturers and measures for their wide implementation.

Sustainable environmental management to achieve decarbonization. Utilization of organic waste and their processing.

This list of priority areas of regulated relations was approved by PDG members at the third training workshop and was recommended for use in the development of the Roadmap.

Annex 4

List of Terms and Definitions

Aridization (from Latin aridus - dry) is a complex of processes of decreasing the degree of moistening of territories, which causes a decrease in the biological productivity of ecosystems by reducing the difference between precipitation and evaporation.

State regulation is a reasonable establishment of rights and obligations, requirements and conditions for conducting certain types of business activities.

Energy decentralization is a type of sectoral policy aimed at the development of small-scale energy.

Household - a form of economic activity, on the use of the property complex, uniting people through labor relations, the smallest and most massive unit of the national economy, a completely independent subject of market relations.

Green certification is a system for assessing compliance with environmental safety and performance requirements, which is applied to buildings.

Green certificate - a certificate for renewable energy (Renewable Energy Certificates) is a financial and regulatory instrument used in the world to implement the renewable energy (RES) quota mechanism and support its development.

Green building standard (Green Building, Sustainable Building) is a type of construction and operation of buildings in which the impact on the environment is minimal.

Engineering services - specialized services for the technical support of certain types of activities from the design stage, the creation of an object to the operation of the object.

Local energy systems based on RES are autonomous complexes for generation, transmission, storage and consumption of energy.

Small power - a segment of the energy (market) sector, which includes small generating installations and small generating complexes, including those not connected to centralized power grids, operating on the basis of traditional fuels and based on renewable energy sources (RES).

Microgeneration is the production (generation) of electricity and heat by objects of very low power. (According to the WADE classification, small or micro generation is the production of electricity on site or near the place of consumption, regardless of size, technology or fuel - both off-grid and in parallel with the grid).

Tourism infrastructure facilities are engineering support systems that consume energy resources, generate, transmit and store energy.

Tourism objects - buildings, structures, engineering infrastructure.

Suppliers - firms, companies, organizations, individual entrepreneurs, producers of goods, works, services.

Consumers – individuals and legal entities intending to use technologies, equipment, resources to obtain clean energy based on renewable energy sources and apply technologies and materials for energy efficient use of resources.

Distribution energy is a model for the operation of a unified energy system that allows small-scale energy entities to supply energy produced to distribution companies.

Energy audit - a type of specialized activity for the provision of expert and consulting services, the conduct of an external assessment of energy efficiency.

Energy efficiency - rational use (consumption) of energy resources with the same quality of tourist services and maintaining (increasing) the level of comfort in compliance with the necessary standards and regulations.