

# International Solar Energy Institute



## Renewable Energy Development in Uzbekistan: Current Status, Problems and Solutions

Nuraddin Matchanov

Tashkent 2019



International Solar Energy Institute

The development of renewable energy (RE) in Uzbekistan (solar energy, wind and biogas, hydropower small natural and artificial watercourses) and energy efficiency are a subject of long-standing concern of society. In the long term, the use of renewable energy sources for the development of Uzbekistan is obvious and necessary to ensure energy, environmental and economic security, as well as to ensure the sustainable development of the energy sector of the country and the preservation of natural resources for future generations, improving the environment.



# Renewable Energy Sources

Over the past 15 years, renewable energy technologies have been actively developed in many countries of the world and have achieved technical and economic indicators showing their competitiveness with traditional technologies for the production of heat and electric energy based on the use of fossil fuels and nuclear energy.

At present, with the total installed capacity of all power plants in the world around 5,000 GW, the capacity of existing power plants in the world using renewable energy technologies, excluding large hydropower stations, approached 1,000 GW and exceeded the capacity of all nuclear power plants (about 350 GW) by 3 times. Investments in renewable energy in recent years amounted to at least \$ 250 billion a year, which is 3 times more than in traditional energy and 5 times more than in nuclear and large hydropower. Since 2013, the annual commissioning of renewable energy in the world significantly exceeds the input of traditional power plants.

The practical development of renewable energy is uneven across regions of the world. Its most rapid development takes place in countries heavily dependent on energy imports and having high energy tariffs. At the same time, even the fact that renewable energy in the foreseeable future will take a significant place in the energy of all countries, including those still rich in fossil fuel reserves. In this regard, support for research and development of promising technologies for the practical use of renewable energy sources is an urgent task for all countries concerned with the development of national scientific and technical competences in this promising area and the prevention of full technological dependence on the import of technologies and equipment in the future.



# RE sources in Uzbekistan

At the present stage of the development of the Russian economy, the use of renewable energy is important both for ensuring energy security and for improving the social conditions of the population and areas remote from centralized power lines. At the same time, the possibility of preserving hydrocarbon fuel reserves for future generations and mitigating the ecological situation is of no small importance.

The main components of renewable energy sources in Uzbekistan are: solar, hydraulic, wind and geothermal energy, as well as biomass energy. According to the results of research carried out by Uzbek scientists, the technical potential of renewable energy sources in Uzbekistan is 270 million tons of reference fuel, which is more than three times the annual need for energy resources.

RE type	Potential in mln. t.o.e./year		
	In Uzbekistan		In the world
	Gross	Technical	Gross
Solar	76459,5	265,1	131x10 <sup>6</sup>
Wind	3,33	0,64	2x10 <sup>6</sup>
Hydraulic	3,43	0,39	7x10 <sup>6</sup>
Biomass	13,8	2,92	0,1x10 <sup>6</sup>
Total	76480,0	269,05	1401x10 <sup>6</sup>



# ANNUAL TECHNICAL POTENTIAL OF RENEWABLE ENERGY SOURCES OF THE REPUBLIC OF UZBEKISTAN





# During a year



**The number of cloudless  
days: 250-270**



**Duration of sunshine:  
2850-3050 hours**



## SOLAR ENERGY RESOURCE INDICATORS FOR CHARACTERISTIC REGIONS IN UZBEKISTAN

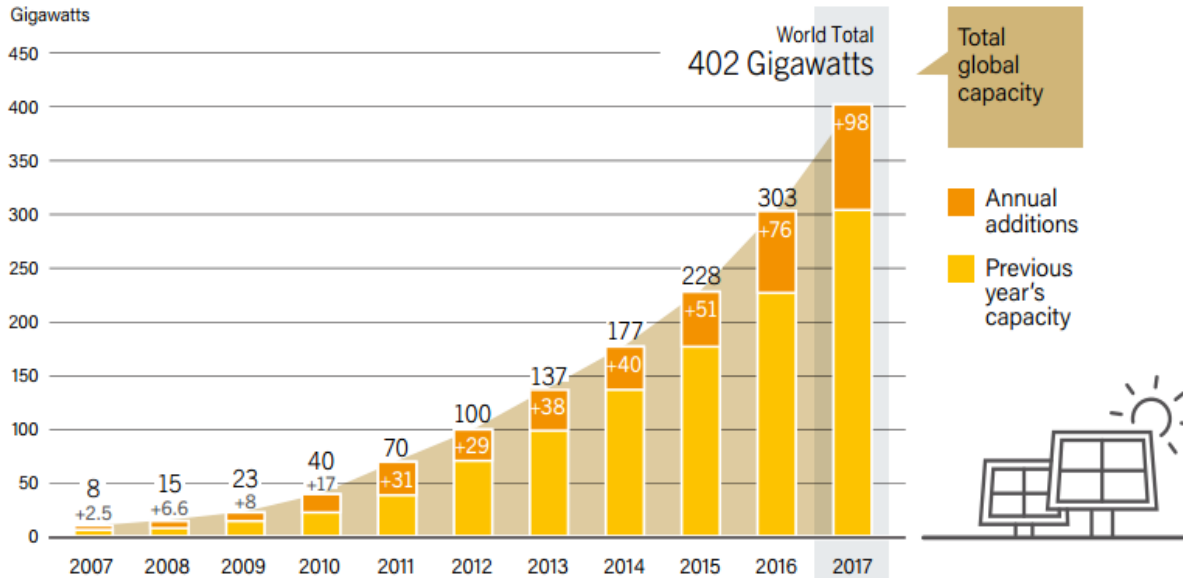
Regions	$q_{\perp},$ $MJ/m^2$	n, hours	$q_{\alpha=30^{\circ}}^{\Sigma},$ $MJ/m^2$
North of the Republic (Republic of Karakalpakstan, Khorezm District and North of Navoi region)	6840-7560	2900-3000	700-7250
South of the Republic (Kashkadarya and Surkhandarya regions)	6840-7056	2950-3050	7600-7700
Fergana Valley (Fergana, Andijan and Namangan regions)	5400-5580	2650-2700	6600-6650
Zarafshan valley (Samarkand, Jizzakh, Bukhara provinces and the south of Navoi region)	6876-7128	2930-3000	7200-7300
Tashkent city	6995	2852	6700





INTERNATIONAL SOLAR

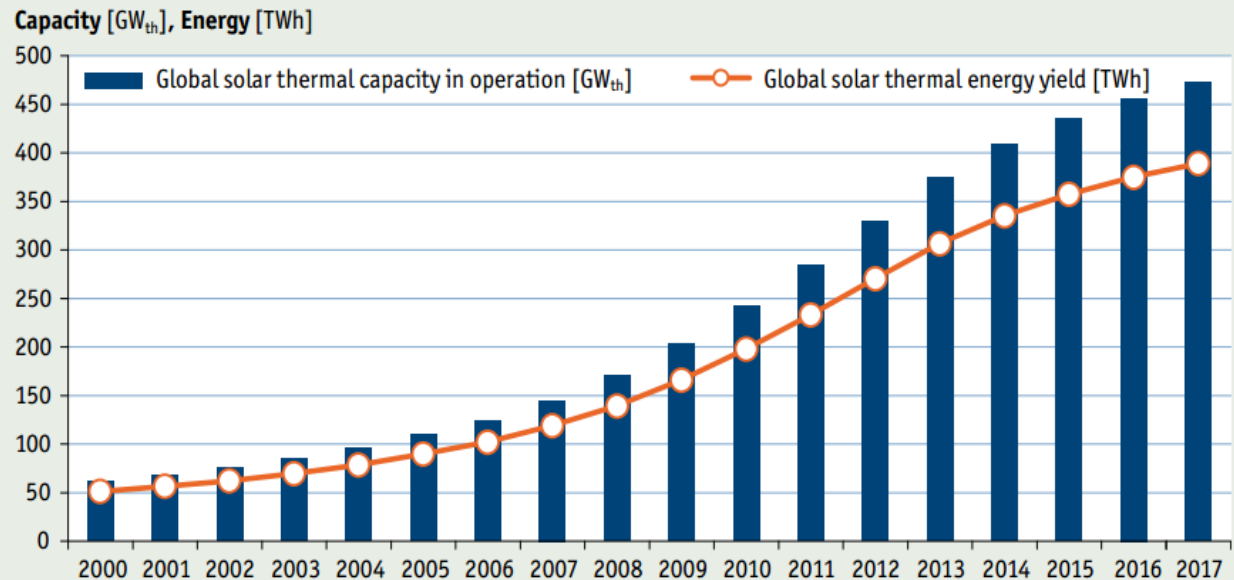
# PV and FPSC development in the world



The growth rate of photovoltaic power in the world over the past 10 years, i.e. from 2007 (8 GW) to 2017 (402 GW), it is 48%. + (2018, 110 GW)

In Uzbekistan - less than 10 MW

The growth rate of the heat output of SCWCs used in the GWHS in the world over the last 10 years, i.e. from 2007 (145 GW) to 2017 (472 GW), it is 12.5%.





- “Mir Solar” LLC;
- “TECHNO FUTURE” FB LLC
- “OFTOB NUR” JV
- “SOLAR CITY SOLUTION” LLC
- “INTELLECT-DIALOG” LLC
- “SOF ENERGIA” LLC
- “SOLAR ENERGY PRODUCTS” LLC
- “PROGRESS ENGINEERING” LLC
- “GLASS EXPRO” FB LLC
- and others.



## Following PV systems are installed in Uzbekistan since 2014

Location	Capacity	Year
Pilot PV station in Pap district (Namangan region)	130 KW	2014
Almalyk Mining Complex (Almalyk district, Tashkent region)	112 KW	2015
Maydanak observatory of Astronomy Institute of Academy of Sciences (Kashkadarya region)	27 KW	2016
Kandim Gas Processing Complex (Karakul district, Bukhara region)	1,2 MW	2016
Energy Department of Tashkent State Technical University (Tashkent city)	20 KW	2016
International Solar Energy Institute (Tashkent city)	28 KW	2017



# Hydro energy sources



Along with the energy of solar radiation, the most studied and technologically prepared for development in the country are hydropower resources. At this stage, the capacity of all operating hydropower plants in Uzbekistan is 1,700 MW with an annual average of many years of electricity generation of about 6 billion kWh, i.e. 12% of electricity generated by all power plants in the country.

Further development of hydropower in Uzbekistan will be carried out by realizing the potential of small rivers, irrigation canals, reservoirs and watercourses, on which it is possible to build about 150 small and micro hydro power plants with an installed capacity of more than 1,700 MW with electricity generation up to 8 billion kWh per year. As can be seen, with the implementation of the technical potential of these small and micro hydropower plants in the republic, the total annual electric power generation by all hydropower plants can be increased to 14-15 billion kWh.



# Wind energy

Along with solar and hydraulic energy, on a part of the territory of the Republic of Uzbekistan with an area of 100 thousand sq.km. (the territory in the Aral Sea areas, the Ustyurt plateau, Navoi, Bukhara and other regions) there are wind flows, the magnitudes and structures of which provide the possibility of wind energy use of their energy with the help of modern serial wind-driven units.

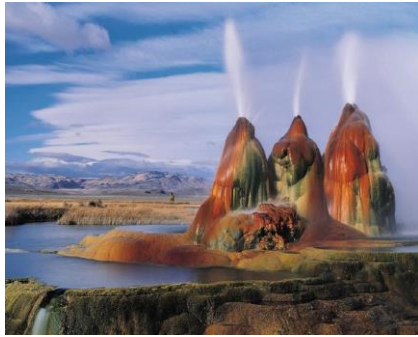
The region between Bekabad and Kokand, where winds prevail with a speed of more than 6 m/s with 42% frequency in a year where 400 wind power plants can be located, is considered promising for the production of electric energy on an industrial scale. The total capacity of 240 MW, with an annual output of more than 800 million kWh of electricity.

The feasibility and feasibility of using wind and solar energy to generate electrical energy have been proven by the practical operation of a pilot combined wind-solar power system with a 3 kW wind power plant and a 5 kW solar photovoltaic plant, created to perfect the power supply of a television broadcasting station in Charvak village of the Tashkent region in the framework of the Inco-Copernicus project of the European Union. Installed industrial wind turbine -750 KW, output 1.3 million KW/h.





# Geothermal energy



Geothermal waters are available in all regions of Uzbekistan. Perennial surveys made it possible to identify 8 large basins with hydrothermal resources on its territory. The gross potential of geothermal waters is estimated at 171 thousand toe. However, the technical potential of geothermal sources has not yet been determined. Fergana valley and Bukhara provinces have the greatest potential of geothermal waters. The average temperature of geothermal waters in the country is  $45.5^{\circ}\text{C}$ , the warmest waters in the Bukhara ( $56^{\circ}\text{C}$ ) and Syrdarya ( $50^{\circ}\text{C}$ ) regions. It should be noted that the practical implementation of the energy of geothermal waters is associated with the development of appropriate environmental protection measures, due to their chemical composition.

The country also revealed petrothermal energy in the form of dry rocks with a temperature of  $45$  to  $300^{\circ}\text{C}$ . Realization of the potential of petrothermal energy (heat of dry rocks, granitoids) can be carried out with the help of power plants at low-boiling working fluids with a capacity of 40 MW unit based on the Chust-Adrasman petrothermal anomaly in the Fergana Valley.

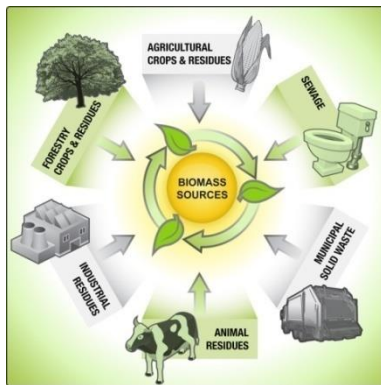






INTERNATIONAL SOLAR  
ENERGY INSTITUTE

# Biomass energy



The prerequisites for the use of agricultural waste in Uzbekistan as biomass are small. Vegetable waste (wheat and rice straw, stalks and tops of vegetable crops, alcohol bard) are used by local people to feed livestock or fuel. Livestock and poultry waste go to fertilizer, harvesting local fuels. One of the possible options for biogas production is the use of “guzapaya”. The technical potential of this type of biomass is estimated from 0.1 to 0.3 million toe. Private entrepreneurs developed a technology for producing fuel briquettes from guzapai, which are not inferior in calorific value to Angren coal. Potential sources for biogas can be solid household waste and activated sludge from municipal wastewater treatment plants. The results of the estimates show that it is economically advantageous to use 2.2 million tons of household waste (garbage) in the republic, whose calorific value is 6.3-10.5 MJ / kg (1.75-2.92 KWh / kg). The total amount of activated sludge generated annually in aeration stations is more than 1 million tons. The resulting biogas can be used to produce heat and electricity at aeration stations, and recycled sludge as a biological fertilizer.

Western investors (Germany, Switzerland) are showing interest in setting up biogas production in Uzbekistan. However, for its practical implementation, a deeper study of the issues of availability of raw materials and adaptation of existing technologies for biogas production to local conditions is necessary.



International Solar Energy Institute

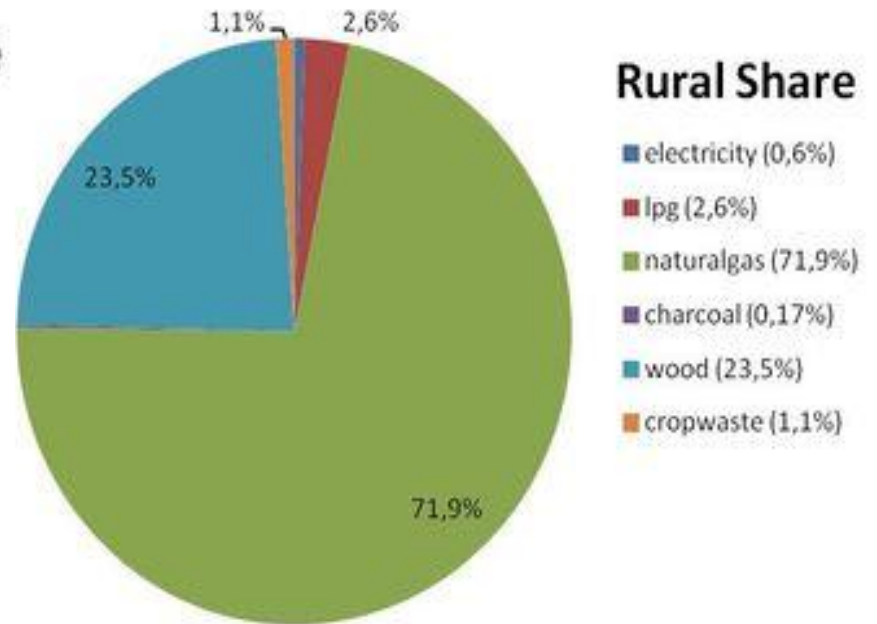
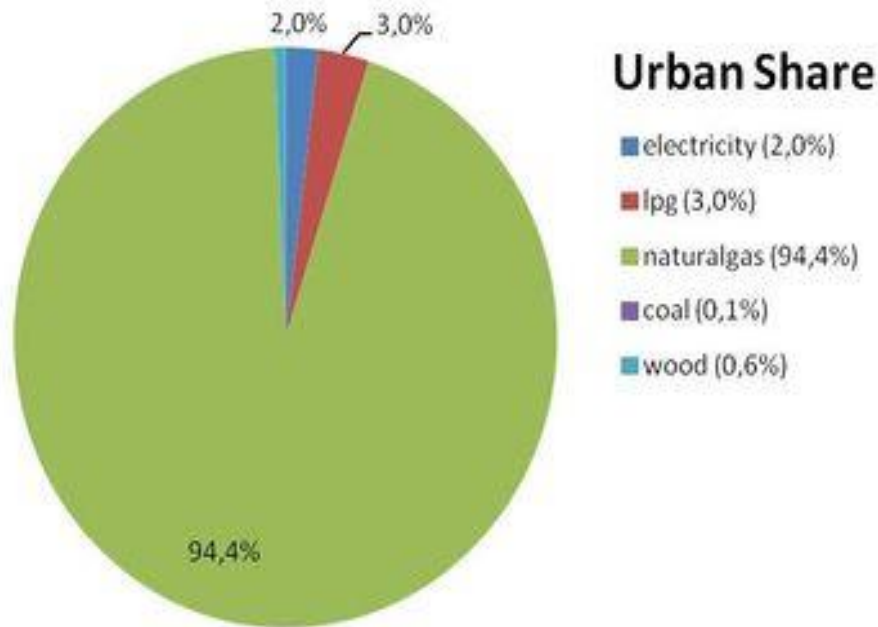
# Main motives for RE development

- The electricity consumption of the country in 2025 will be increased by about 2 times against the year of 2015 and will amount to over 117 billion kWh;
- Oil and natural gas comprise 97% of the country's energy balance;
- Primary energy shares consist of 86.3% gas, 1.9% hydro, 2.5% coal, and 9.3% crude oil;
- The national electrification rate is 94.4%, but electrical supply to rural areas is unreliable and of low quality;
- Potential of solar, wind and hydro energy at over 1126 billion kWh;
- Fossil fuel resources are decreasing.



# Main motives for RE development

## Household Energy Situation



- The total national electric capacity is 14.1 GW (as of 2018), of which 9.9% is provided by hydroelectric power stations - 1.4 GW;
- 50 billion t.o.e. potential of solar energy, but installed PV system with a capacity of 130 KW connected to the network in Namangan, autonomous SFES with a capacity of 1.2 MW in Bukhara and approximately 7-8 MW of capacity of small autonomous photovoltaic stations;
- Wind energy resources exceed 520,000 MW of installed capacity. One 750 KW wind power plant installed in the Tashkent region;
- Uncertain power of biogas and small individual biogas plants in farms.



- **Organizations in the field of RE:**

- Uzhydroenergy
- International Solar Energy Institute
- SPA “Physics-Sun” of Academy of Sciences
- Association of “Enterprises of alternative types of fuel and energy”;
- More than 50 assembling companies and installers;
- Supporting: Ministries of Uzbekistan and international organizations such as WB, ADB, IFC, IsDB.

- **Regulation documents in the field of RE:**

- Presidential Decree No. PD-4512 “On Measures for Further Development of Alternative Energy Sources” from 01.03.2013;
- Presidential Resolution No. PR-1929 “On Establishment of the International Solar Energy Institute” from 01.03.2013;
- Presidential Resolution No. PR-2343 “On the Program of Measures to Reduce Energy Intensity, the Introduction of Energy-Saving Technologies in the Economic and Social Sectors for 2015-2019” from 05.05.2015;
- Presidential Resolution No. 2912 “On the Program for Development of Heat Supply System over the period of 2019-2022” from 20.04.2017;
- Presidential Resolution No. 3012 “On the Program of measures for Further Development of Renewable Energy, Enhancement of Power Efficiency in Sectors of Economy and Social Sphere over the period of 2017-2021” from 26.05.2017.





- **Activities implemented or in progress:**
  - Development of national standards on the basis of international standards (IEC, ISO);
  - Development of grid code and interconnection regulations;
  - Creation of test and demonstration area in polygon of ISEI;
  - Establishment of training center in polygon of ISEI;
  - Creation of certification laboratory of solar technologies in ISEI;
  - Research and development activities.



- **Legal base is not developed fully;**
  - Law on RE
  - Subordinate legislation
  - Norms, regulations and standards
- **Economic and financial mechanisms are not developed;**
  - Green tariffs
  - Tax regulations
  - economic stimulation
- **Authorized organization (institution) on RE is not established;**
  - For propaganda of RE
  - For control and coordinating
  - For development of legal base and programs



- **Adoption of RE Law and development of subordinate legislation**
- **Development of economic and financial mechanisms**
- **Establishment of authorized organizations**
- **Establishment of special fund for RE**
- **Development and implementation of national programs on development of using renewable energy sources in Uzbekistan**



# 130 KW solar power station in Namangan (Pap district)





## 1.2 MW solar power station in Bukhara (Karakul district)





# 27 KW PV system in ISEI

“International Solar Energy Institute” LLC





# Operating heliosystems in Uzbekistan



10 KW PV station in Samarkand



Heliosystem of hot water supply  
and 2 KW PV station in Fergana



2 KW PV station in Andijan



Heliosystem of hot water supply  
in Fergana



Heliosystem of hot water supply  
in Samarkand



Energy storage system of 40  
accumulators



The singularly important role energy plays in human lives, and in society as a whole, has made it possible to increase many times over the possibilities for satisfying various human and social needs. The progress of human civilization has always been closely associated with the amount and types of energy utilized.





INTERNATIONAL SOLAR  
ENERGY INSTITUTE



**Thank you for your attention!**



International Solar Energy Institute