INNOVATIVE WORLD

ISSN: 3030-3079
Impact Factor: SJIF X.XXX

ORIENTAL JOURNAL OF ACADEMIC AND MULTIDISCIPLINARY RESEARCH

Open Access, Peer Reviewed Journal

Scientific Journal

www.inno-world.uz
+998 33 0178868

ISSN 3030-3079

ALTERNATIVE ENERGY: PROBLEMS AND PROSPECTS OF USE

Nasirov Ilham Zakirovich-Professor of the Department
Abbasov Saidolimhon Jaloliddin ugli-Doctoral student
Qozibolayeva Dilnoza Toxtasinovna-Doctoral student
Andijan Engineering Institute
of the Republic of Uzbekistan, Andijan

KEY WORDS

Power plants, hydropower, evaporation, hydrogen, internal combustion engine, exhaust gases, environment, hydrogen-air mixture, gasoline, octane number, detonation, fuel consumption, carbon monoxide, unburned hydrocarbon

ABSTRACT

The world needs more energy, and, if possible, for less money. To meet the growing global demands, the energy sector needs qualitative changes. The use of renewable energy sources (RES), the decentralization of generation and the widespread introduction of smart grids will lead to a radical reduction in the cost of electricity.

Why alternative energy is needed

The growth of energy consumption in the world

Global energy consumption is growing. Although traditional industries and services are becoming more energy efficient, the growth of the world's population and the emergence of new services leads to an increase in total energy consumption. In 2015, global energy consumption amounted to 20.76 trillion kWh, according to the International Energy Agency, the forecast for 2030 is 33.4 trillion kWh, and by 2050 — up to 41.3 trillion kWh.

The digital economy accounts for about a tenth of global energy consumption, but this share is increasing. For example, a couple of years ago, cryptocurrency mining was the domain of geeks, and now this area consumes more energy on a global scale than many countries. For example, Bitcoin mining "eats up" 14.6 TWh per year, and Tajikistan's consumption per year is only 13 TWh, according to DigiEconomist, but there are also other cryptocurrencies, for example, Ethereum mining takes about 5 TWh per year.

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The place of alternative sources in power generation

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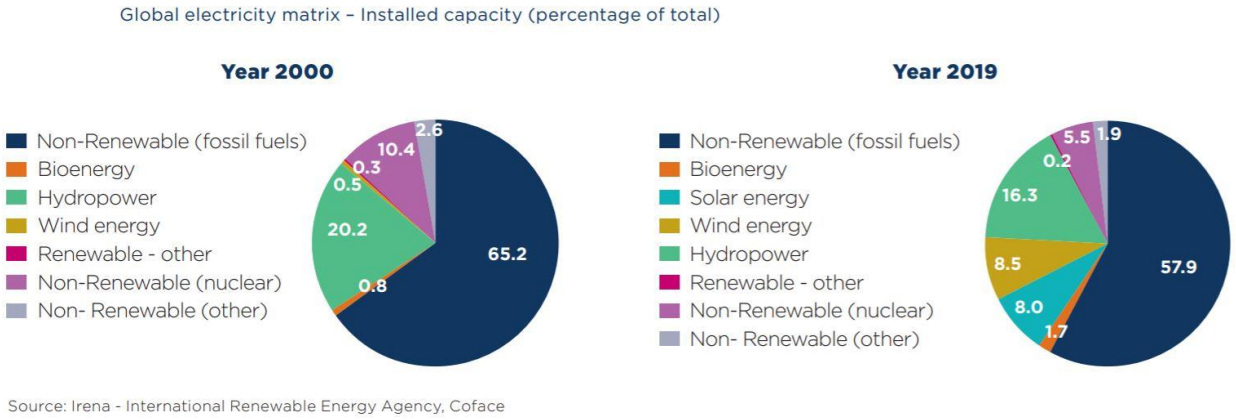

Directions of alternative energy

The use of renewable energy sources (RES) is most often considered by public opinion in the context of "green energy", which has a minimal impact on the environment in the process of operation, and considers this a very innovative direction that has appeared quite recently. However, this is not entirely true.

A classic example of generating capacities using renewable energy sources are hydroelectric power plants, which have been built around the world for more than a century. Wind, tidal, solar, geothermal and other renewable energy power plants were also developed many decades ago, and such solutions can be based on a variety of technological approaches. For example, solar panels can be equipped with semiconductor panels that directly "convert" light into electricity, or they can be a system of mirrors that focus light on a tank and heat the liquid contained there, which turns the turbine. There are also many variations of tidal power plants.

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Renewable energy power plants are unstable. For obvious reason, solar power plants do not generate electricity at night, and "green" solutions built on other principles in most cases also strongly depend on the vagaries of the weather: for example, calm comes — wind farms stand idle, and wave power drops by orders of magnitude.

Seasonal phenomena can also significantly change the effectiveness of VI-stations for reasons known from the school course of natural sciences and physical geography. In winter, daylight hours decrease, there are fewer clear

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days and the sun is lower above the horizon — and electricity generation by solar panels decreases not by percentages, but at times.

This means that the "green power plants" will be operated in parallel with the generating facilities of traditional energy. The resulting synthesis provides a reduction in the price of electricity while maintaining the stability of the energy supply. But other solutions are increasingly being used to mitigate the situation caused by the instability of renewable energy power plants. The situation may be somewhat mitigated by energy accumulators.

Hydropower

The world's most reliable renewable energy source is not wind or sunlight, but water. In 2019, global hydropower capacity reached a record 1,308 gigawatts. Hydropower is cheap, easy to store and ship, produced without burning fuel, and therefore environmentally friendly. Water power was in high demand during the Covid-19 pandemic, as electricity production was little affected due to the degree of automation of modern facilities. However, as with other energy sources, hydropower is not without environmental costs and can damage local aquatic ecosystems.

Electricity by evaporation of water

Evaporation is the process by which a substance passes from a liquid state to a gaseous one. As a rule, evaporation is a consequence of heating a substance to a certain temperature. It is thanks to evaporation that the water cycle is maintained on Earth, and in this case the Sun acts as the evaporator. The scale of energy that is spent on the evaporation process throughout the planet is actually very large, although we do not notice it in everyday life.

According to Ozgur Sahin and his colleagues from Columbia University, the water that evaporates from all rivers, lakes and dams in the territory of the modern United States (with the exception of the Great Lakes) It can provide up to 2.85 million megawatt hours of electricity per year. For comparison, this is equivalent to two thirds of the electricity produced in all US states in 2015! And this is despite the fact that in 15 of the 47 states, the potential capacity of power plants exceeds the real demand for energy.

Engines of the future: it's all about water

The researchers propose to install engines in freshwater reservoirs, which would not only generate electricity, but also halve the intensity of evaporation itself, which in many situations would save huge reserves of drinking water. However, such technology assumes that the water body will be covered with absorbing panels — which is highly undesirable. To begin with, however, it is necessary to build the evaporation engine itself, but here scientists have already demonstrated the full power of science and created several miniature, but quite working prototypes of the installation.

Test engines are based on materials that shrink when dried — for example, a tape covered with bacterial spores is involved in the design. Losing water, the spores shrink and shrink, while reducing the ribbon. Sahin

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compares the principle of operation of this structure with the muscular system, explaining that microscopic spores can pull the tape with quite a lot of force. To avoid soil contamination due to repeated soaking and an abundance of chemicals, the prototypes adjust their operation depending on changes in the overall humidity level. For example, in one version of the engine, the "muscle" is located just above the water layer. When the evaporating moisture rises, the tapes stretched according to the principle of blinds are straightened and create cracks, thanks to which air enters them and helps the tapes to dry again and avoid waterlogging.

Advantages and disadvantages of the invention

The scientific community agrees that the potential of this invention is huge. To date, the main problems lie in its use. Ken Caldeira of the Carnegie Institution for Science in Stanford, California, doubts that it is possible to efficiently convert evaporation energy into electrical energy. In his opinion, the industrial development of engines to the extent that their production becomes widespread and their use is widespread is an extremely time—consuming task.

The main competitor of the new engines are the well-known solar panels, since it is increasingly common for floating solar farms to place them on reservoirs. However, evaporative engines can be made from cheap biomaterials, which are easier to recycle than solar panels — and this is important.

If the technology becomes widespread, its use will also affect the local climate by changing the degree of evaporation of water. But this will make at least some difference only if the area of the closed surface is 250,000 km2 or more. However, when it comes to such a scale, any power plant, no matter how environmentally friendly it is, will have an impact on the environment. Moreover, in rainy areas, where frequent precipitation causes many problems, reducing the intensity of water evaporation will be extremely useful.

"Rain batteries"

Not only solar, but also "rain batteries" will appear in the world. In February 2020, it became known about the development of a method for generating electricity due to the fall of rainwater, which allows increasing the energy efficiency of the process by thousands of times. The first electric generator based on the new technology can be created in five years.

A group of scientists from several scientific organizations in China and the United States has developed a fundamentally new way to generate electricity by dropping rainwater on the surface. RIA Novosti writes about this with reference to a scientific article in the journal Nature. This method allows you to increase the capacity of such installations by thousands of times compared to existing prototypes.

"Our study shows that a drop of 100 microliters of water falling from a height of 15 centimeters can generate a voltage of over 140 volts. And due to

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its power, 100 small LED lamps can be powered," the head of the research group Wang Tsuankai from the City University of Hong Kong is quoted in a press release.

An abrupt increase in the power of such generators was achieved thanks to the idea of covering them with a special polytetrafluoroethylene (PTFE) film. It is capable of accumulating a surface charge with continuous ingress of water droplets until it reaches saturation. In such a device, the droplets act as resistors, and the surface coating acts as a capacitor, the agency's publication notes.

The first prototype of a "rain" electric generator for practical use will be created in the next five years, according to the scientific group. If its tests are successful, analogues of solar panels may appear in the world for use in heavy rain conditions. For example, innovative umbrellas with the function of charging phones. Or "rain batteries" designed for use in certain regions during the heavy rainy season.

Interestingly, 13 scientists from five scientific organizations were involved in a unique scientific study at once. In addition to the City University of Hong Kong, these are the University of Nebraska-Lincoln in the USA, the University of Science and Technology of the People's Republic of China, the University of Electronic Sciences and Technology of China, as well as the Institute of Nanoenergy and Nanosystems of the Beijing branch of the Chinese Academy of Sciences.

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