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ENERGY SECURITY PARADIGM: HYDROGEN IS THE MAIN ENERGY CARRIER OF THE XXI CENTURY

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Abstract The article presents the main problems of energy security and global environmental problems (climate change, excessive environmental pollution, etc.). The relevance of the development and use of alternative environmentally friendly fuel-hydrogen, the share of which in the fuel and energy complex is commensurate with the share of organic fuel, is substantiated. An autonomous

technical complex for the production of environmentally friendly hydrogen using a hybrid solar-wind power plant in areas without infrastructure is proposed.

Keywords: hydrogen, climate change, renewable energy, energy carrier, hybrid, solar-wind power plant, hydrogen generator, autonomous technical complex

In connection with the depletion of hydrocarbon reserves around the world, work is underway to find alternative sources of energy and energy carriers. To date, it is relevant to transfer internal combustion engines to hydrogen or gasoline-hydrogen composite fuel. At the same time, in many countries of the world, independently, unfortunately, separately, they are developing technology for the transition to hydrogen fuel. The main focus on the development of hydrogen energy was formulated in the mid-1970s at the height of the first wave of the energy crisis. It was based on the idea of hydrogen as an alternative environmentally friendly fuel, the share of which in the fuel and energy complex was assumed to be commensurate with the share of organic fuel. At the global level, many scientific events dedicated to hydrogen were organized and held, where all participants expressed the opinion that the widespread use of hydrogen in energy "gives humanity a unique chance to survive in a world free from environmental and social disasters."

However, today this issue is more acute and tough. On the pages of information and analytical publications, reports systematically appear on the use of hydrogen in various installations, including also in aircraft enginesNaturally, data are provided on the environmental, technological, economic and mechanical aspects of the raw materials and technology used. It should be noted that today the world has come close to the widespread implementation of the transition to hydrogen and/or gasoline-hydrogen composite fuel mixture for use in internal combustion engines.

Currently, more than 1,200 filling stations are already operating in the United States and European countries, filling with compressed (liquid) hydrogen fuel.

The relevance of using environmentally friendly fuel lies in the fact that in recent decades global environmental problems have arisen on the planet (climate change, excessive environmental pollution, etc.). According to available estimates,

the annual release of carbon dioxide into the atmosphere exceeds 33 gigatons, and the volume of greenhouse gases amounted to approximately 41 billion tons. In the world, the volume of harmful emissions has increased by 3.8 times compared to the 50s and has a steady upward trend.

The advantages of hydrogen as a fuel are connected not only with the fact that when it is burned, "environmentally friendly" water vapor is formed. Compared to organic fuel, it has a large "energy reserve": when burning 1 ton of hydrogen, the same amount of heat is released as when burning 3.5 tons of fossil fuel. In addition, hydrogen, unlike hydrocarbon fuels, is capable of catalytic oxidation at low temperatures with direct conversion of the chemical energy of oxidation into electrical energy, which can be a decisive argument for the use of hydrogen in the energy sector.

Devices that make it possible to realize this unique feature, the so-called fuel cells or electrochemical power generators, are characterized by very high efficiency. - 70 - 80%, that is, 2 - 2.5 times higher than the efficiency. Thermal engines. Obviously, for the widespread use of any type of fuel in the sectors of the economy, at least two conditions must be met:

firstly, this fuel should be available and relatively economically inexpensive;

secondly, an optimal technology for its production should be developed and industrial devices should be created for its implementation;

All its stages of implementation are connected with the fact that there is no hydrogen in a free state on Earth, and for its production it is necessary to have available chemical raw materials and primary energy sources. In other words, hydrogen is not a fuel, but an energy carrier. All its stages of implementation are connected with the fact that there is no hydrogen in a free state on Earth, and for its production it is necessary to have available chemical raw materials and primary energy sources. In other words, **hydrogen is not a fuel, but an energy carrier.**

Hydrogen consumers are usually divided into the following main groups:

1) consumers of liquid hydrogen - for their service, as a rule, specialized vehicles and containers are used.

2) high-pressure hydrogen consumers (in cylinders) - for their maintenance, high-purity gas is mainly used - this is hydrogen obtained by electrolysis of water.

3) consumers of low-pressure hydrogen - this group includes the main consumers to which gas is delivered, as a rule, by pipeline transport - local lines of the hydrogen supply system.

Consumers of the first group do not yet make up the main part among the operators, however, the prospect of this part is inevitable, since cryogenic technology everywhere shows the need to implement it in life, as there is no technology more than environmentally and economically beneficial today, therefore, many research centers in the world are working on these problems. The world. For example, it is no coincidence that the international organization "Cold" (Refrigeration), headquartered in Paris, pays special attention to the development of developments for the production and use of liquefied hydrogen in the economic sectors.

Over the past 30 years, hydrogen production in the world has increased significantly. According to forecasts, by 2025 there will be a further increase in its production, ensuring the development of the chemical industry and energy.

For example, only in the USA there are currently dozens of enterprises of various capacities specialized in the production of hydrogen.

There are two main industrial methods for its production. One of them, really environmentally friendly, is based on electrolysis or electrochemical decomposition of water or steam. In this case, the primary source of energy is the electric current generator. The advantage of electrolytic hydrogen is that the methods of its additional purification (up to an impurity content of less than 10"1 vol.%) are economical and technologically simple. That is why electrolytic hydrogen is used to obtain pure and high-purity hydrogen. At the same time, classically, the most promising and not only ecological, but also in the future the most economical will be the production of hydrogen by electrolysis of water, that is, its decomposition under the influence of electric current. The energy that will be applied to the electrolysis of water is a truly environmentally friendly integrated technology. If we switch to hydrogen energy,

some emissions (NOx and CO) will decrease significantly, and some (SO_2 and particulate matter) will not exist at all.

It should be noted that the share of electrochemical methods in the total volume of hydrogen production still does not exceed 2–4%, although in some countries, for example, in Canada, Norway, the USA, and China, it is significantly higher. The prospect of developing these methods and the cost or "availability" of electrolytic environmentally friendly hydrogen largely depends on the availability of "cheap" or "expensive" electricity. However, the development of science and technology is now confidently asserting itself in this role of renewable energy sources - mainly solar (solar) energy. Additional opportunities to reduce the cost of electrolytic hydrogen are associated with the improvement of water (steam) electrolysis methods. In this regard, it is also promising to use hydrogen energy as a heat source for sand heat accumulators, which can reserve heat for heating apartment buildings for a long time from several weeks to a month.

The tasks of scientists and specialists in the development of hydrogen energy, in our opinion, are as follows:

- search and study of new promising materials and processes in the field of hydrogen energy;
- research on the rational and efficient use of integrated environmentally friendly and independent of natural resources technologies aimed at producing hydrogen by the electrolytic method, using local potentials of renewable energy sources;
- organize scientific support of industrial developments on hydrogen technology by all interested research institutes, experimental design organizations;
- development of forecasts for the development of hydrogen energy in the world and in the country.

At present, studies conducted in the republic, taking into account the existing local conditions, show that hydrogen remains practically the only environmentally friendly fuel for road transport, and, more broadly, for any autonomous energy facilities of the future. In recent years, our scientists have been working on the

creation of a pilot plant for the production of hydrogen in an environmentally friendly way. It uses electrical energy generated by photoconverters and a wind generator to decompose a water molecule. To date, encouraging results have been achieved on the viability of the chosen technology, since the cost of electrical energy generated by photoconverters and a wind generator is practically on the same level as electrical energy generated by traditional technology.

In recent years, a number of Decrees, resolutions of the President and decisions of the Government of the Republic of Uzbekistan have been adopted to accelerate and expand research, and the introduction of such energy sources. State authorities have been given specific tasks to significantly reduce electricity consumption by up to 30% through the use of automated systems, solar and wind installations.

In this regard, the following priority areas of work are currently being put forward in Uzbekistan:

a) development of technology for the production of hydrogen by electrolysis of water using solar and wind energy for this, with the subsequent creation of fuel cells for the domestic and foreign markets;

b) development of complexes for the production, purification, accumulation, storage and transportation of hydrogen;

c) creation of highly efficient power plants and electrochemical generators of a wide class based on fuel cells, including those for use in consumer electronic devices;

d) development of infrastructure elements for hydrogen energy;

e) introduction of technologically safe and environmentally friendly methods of hydrogen storage and transportation, etc.

In general, the use of hydrogen plants and power systems makes it possible to obtain the required power ratings with relatively low unit costs for energy sources compared to traditional energy carriers.

As part of research on the creation of new engineering and technological complexes in this area, a group of scientists consisting of A. Abdullaev, B. Alikhanov and R. Isaev with the participation of specialists V. Korolev, G. Gulyamkhadzhaev and Ya. Mankovsky developed a new technical solution for the rational use of

autonomous a technical complex based on hybrid sources of electrical energy operating on solar and wind energy in combination with hydrogen technology systems (hereinafter referred to as AVK) [1].

AVK feature:

no energy and communication

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

production of hydrogen gas by electrolysis of water;

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

environmentally friendly and no polluting emissions.

Devices that make it possible to realize this unique feature, the so-called fuel cells or electrochemical power generators, are characterized by very high efficiency. - 70 - 80%, that is, 2 - 2.5 times higher than the efficiency. Thermal engines.

The main nodes of AVK:

a) a hybrid installation for providing electricity based on photoconverters and a wind generator;

b) a water generator for obtaining water from the ambient atmospheric air;

c) hydrogen filling station.

Figure 1 shows a block diagram of an autonomous technical complex based on hybrid energy sources and a hydrogen system.

How AVC works.

AVC consists of three modules:

the first module is a power generation module;

the second module is a water generator and a hydrogen generator;

the third module is the main consumers of hydrogen energy.

The first module is designed to generate electrical energy from renewable energy sources: photoconverters and a wind generator

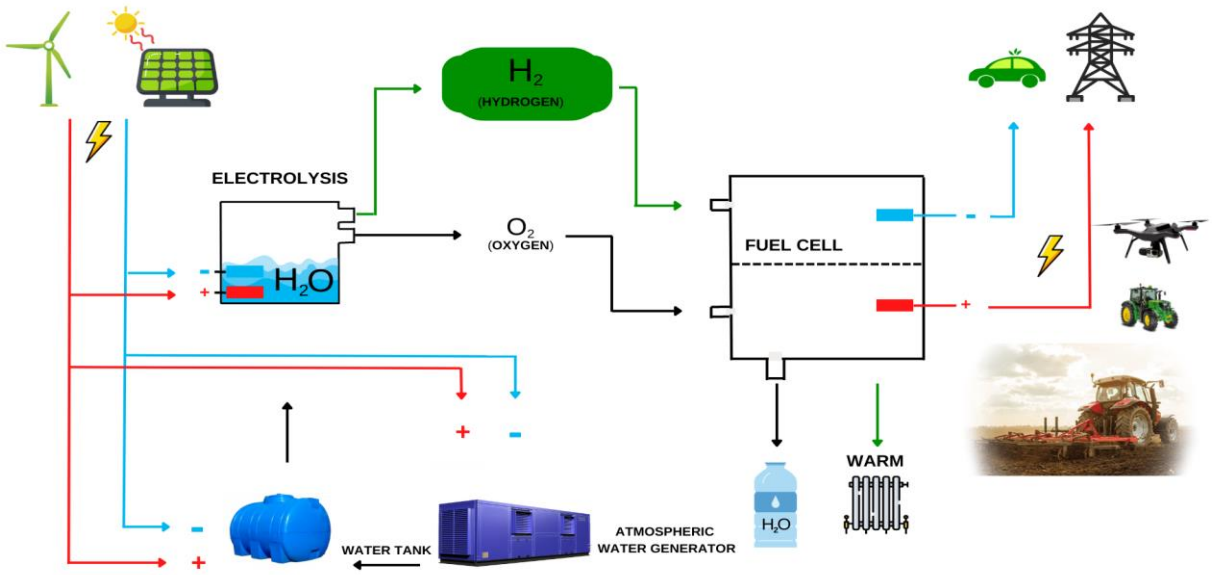

Figure. 1. Structural diagram of an autonomous technical complex based on hybrid energy sources and a hydrogen system

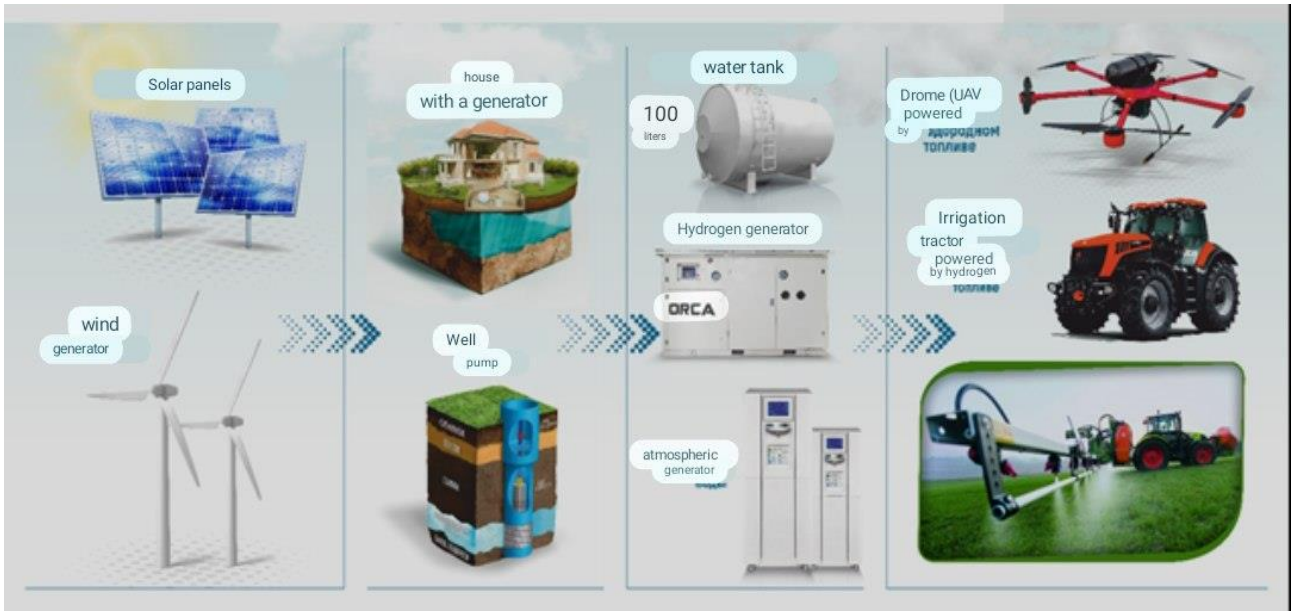

Figure 2. Functional diagram of an autonomous technical complex

The resulting electrical energy is transferred to the second module - a hydrogen generator and a generator for obtaining water from the atmosphere, as well as to the third module - consumers of hydrogen energy**.**

The hydrogen generator is designed to produce gaseous hydrogen, the raw material source of which is distilled water. Water enters the hydrogen generator from the water generator, which produces water from atmospheric air.

The hydrogen generator electrolyzes clean water, extracts hydrogen gas and sends it to the built-in storage vessel, from where the hydrogen plant is refueled. All these elements make up a single hydrogen refueling station.

At the moment, there is a hydrogen filling station based on an ORCA type hydrogen generator (located in Nukus), a new product based on energy saving and environmental protection technology. The hydrogen fueling station is used to refuel hydrogen cylinders of unmanned aerial vehicles (UAVs) and agricultural machinery equipped with hydrogen fuel cells.

The hydrogen charging station is highly integrated and fully automated, it can generate hydrogen, it is easy to set up, and it uses natural water, it is very easy to operate. The station is independent of atmospheric disturbances and is explosion-proof, as well as equipped with an alarm system.

Figure.3. Hydrogen generator

Currently, work is underway on the use of AVC for irrigation of agricultural land using hybrid solar-wind power plants and hydrogen fuel for agricultural

machinery and other consumers in areas without infrastructure, which consists of several modules combined into a single multifunctional system:

module of renewable energy sources (photoconverters, wind generators);

water supply module for irrigation of agricultural land (well and pump);

water storage module (reservoir or waterproofed pool);

drinking water module (atmospheric water generator);

hydrogen fuel module (hydrogen generator, obtaining compressed hydrogen from water);

agricultural equipment, UAVs and hydrogen-powered vehicles.

From the above, it can be noted that the relevance of this direction lies in the development of new technologies for the production of hydrogen from water using hybrid solar and wind energy.

Based on the results of continuous monitoring of climate data of world cities (https://ru.Climate-data.Org/), it is known that Uzbekistan has an average of 3633.4 hours of sunshine per year. Given that in recent years, many scientists have put forward scientific justifications for the advisability of using solar energy, even in cities where there is a low number of hours of sunshine per year. For example, Murmansk (Russia) - 1715 hours of sunshine, Kiruna (Sweden) - 1680 hours, Cologne (Germany) - 1500 hours, Birmingham (Great Britain) - 1400 hours per year. In the conditions of our country, with such a potential for sunny days a year, it is simply unacceptable to ignore or neglect the use of renewable energy sources!

The application of the proposed technology will successfully serve to obtain an environmentally friendly way of electrical energy. In addition, it should be noted that the Republic of Uzbekistan is located in the arid zone of the middle zone of the globe, which necessitates the widespread use of hydrogen, the production of which is based on cryogenic technology.

The use of hydrogen in cryogenic technology will give a new impetus to the development of many sectors of the country's economy.

List of used literature

1. A.Kh. Abdullaev, B.B. Alikhanov, R.Isaev, V.V. Korolev, G.Sh. Ikromkhuzhaev, Ya.I. Mankovsky "AUTONOMOUS TECHNICAL COMPLEX" for irrigation of agricultural land using renewable energy sources and the production of hydrogen fuel for agricultural machinery, in areas where there is no infrastructure. Certificate No. 004658 dated April 11, 2022. About the deposit of the object of copyright.

2. A. Yu. Ramenskii, P. B. Shelishch, and S. I. Nefedkin. The use of hydrogen as a motor fuel for automotive internal combustion engines. History, present and prospects. International Scientific Journal "Alternative Energy and Ecology", AEE No. Ts(43), 2006, 63-70s.

3. M.S. Chentsov, V.S. Sokolov, N.S. Prokhorov, The concept of a plant for hydrogen production by reforming diesel fuel as part of an atmospheric-independent power plant with electrochemical generators for a non-nuclear submarine. International Scientific Journal "Alternative Energy and Ecology", AEE No. 11 (43), 2006, 39-46s.

4. A.G. Galeev, Problems of ensuring the safety of bench tests of propulsion and power plants running on hydrogen fuel. International scientific journal "Alternative energy and ecology". AEE No. 11(43), 2006, 23-27s.

5. Koltun M.M. Solar cells. - M.: Nauka, 1987.

6. Fabian R, Bovchers R/, Wkiler K.N. S.A. S/Geophys. Res/ 1974/ 1979v. 84, p. 3149-3154.

7. Chameides W.L.//Nature, 1983, v.301, p.153.

8. Rybach L. Status and prospects of geothermal heat pumps (GHP) in Europe and worldwide; sustainability aspects of GHPs. International course of geothermal heat pumps, 2002.

9. Helman. O. Introduction to the theory of optimal search. - M.: Nauka. - 1985, 421s.

10. Allaev K.R. Energy of the world and Uzbekistan. Zh. "Problems of energy and resource saving", 2003, No. 1-2. 7-22s.

11. Electronic resource: Sand heat accumulator: can this thermal energy storage technology give a new impetus to the development of "green" energy? / Offtopic / iXBT Live.

12. Electronic resource: Climatic data of cities around the world // https://ru.Climate-data.Org.