

Imperatives of Green Energy Strategy in Azerbaijan

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Abstract: The establishment of a green energy network in Azerbaijan is one of the priorities of the state. According to estimates, the total potential of the country's green energy is estimated at 27 thousand MW. This further expands the great potential of wind energy in the Azerbaijani sector of the Caspian Sea. On the other hand, the availability of sufficient green energy resources in the liberated lands necessitates the creation of an energy system on this basis. In this regard, President Ilham Aliyev declared the Karabakh and East Zangazur economic regions a green energy zone. At present, large-scale projects in this direction are being implemented in the country. Based on all this, the article focuses on global trends in the green energy sector in the context of the imperatives of the green energy strategy in Azerbaijan, priority issues such as green economy, green development, as well as realities reflecting the current situation in this area in Azerbaijan. In this regard, substantial results were obtained and proposals were put forward in the context of the imperatives of the green energy strategy in Azerbaijan.

Key words: Green energy, alternative energy sources, green economy, green growth.

1. Introduction

In the modern world, it is difficult to imagine the development of economic life of people, society, economy without electric power. This reality was on the same basis in all the industrial revolutions that took place. And the Second Industrial Revolution, conditioned by the increase in the scale of mass production and the expansion of its development, owes precisely directly to electricity. The Third Industrial Revolution based on the use of electronics and information technologies to automate the production we are experiencing and the New Fourth Industrial Revolution ("Industry 4.0"), which characterizes the widespread use of ultra-automation of production, robotics and artificial intelligence in business, government and private life, is also closely connected with the carrier segment of electricity [1, 2].

The reality is that the production of electricity is considered an important indicator of the strength of the country's economic potential. Trends in the globalized world show that the demand for electricity continues at

a rising pace. This growth will exceed the current indicators of production and consumption by another 25%-30% on average over the next two decades. According to the IEA (International Energy Agency), over the past 130 years, its total volume has reached the current 9 TBts from 28,500 billion kWh [3].

Eighty percent (80%) of the global energy balance is based on fossil fuels, more than half are hydrocarbon reserves. This means that in 2021, about 36 billion tons of global greenhouse gas emissions were released with 50 billion tons of carbon dioxide energy. Statistics show that the use of traditional types of energy in the new millennium—the burning of fossil fuels—brings great environmental problems to the planet [4]. In order to reduce the severity of this problem and to eliminate it, along with the use of traditional energy sources, efforts are being made to involve alternative non-traditional energy resources in wide economic turnover, strategies are being built in this direction, state programs are being developed, appropriate institutionalization is being implemented [5, 6]. Meanwhile, the focus is more on the concept of green

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energy. Unlike fossil fuels when producing green energy, such as any type of energy produced from natural resources such as sunlight, wind or water, the emission of greenhouse gases into the atmosphere is not directed and, in this regard, the environment is not harmed during its creation. And this reality testifies to its environmental friendliness.

The establishment of a green energy network in Azerbaijan, which has abundant energy resources, is among the priorities of the state. It is reflected in all the main documents of the concept of reforms in the energy sector as the main strategic line. According to estimates, the total green energy potential of the country is estimated at about 27 thousand MW [7]. The huge wind energy community in the Azerbaijani sector of the Caspian Sea contributes a lot to this potential.

After the great Karabakh victory, President of the Republic of Azerbaijan Ilham Aliyev declared the Karabakh and East Zangazur economic regions a Green Energy Zone. By his order “on approval of Azerbaijan 2030: national priorities for socio-economic development”, development priorities as a country of clean environment and “green growth” were established in the liberated territories [8]. It should be noted that these priorities are of particular importance for the implementation of the UN’s obligations arising from the “Transformation of Our World: The Agenda for Sustainable Development by 2030”. It should be emphasized that the implementation of those priorities is reflected in the “Socio-economic Development Strategy of the Republic of Azerbaijan in 2022-2026” and in the “Action Plan for the Creation of a Green Energy Zone in Territories Liberated from Occupation” covering the years 2022-2026 [8]. At present, practical measures are being implemented in the country on various programs and projects of a large scale in this direction.

Based on all this, the article has become an object of study of global trends in the field of green energy in the context of the imperatives of the green energy strategy in Azerbaijan, priority issues such as green economy,

green growth and sustainable development, as well as realities reflecting the current situation in this area in Azerbaijan.

2. Green Energy Concepts: Terminology, System of Indicators and Methodology

An in-depth study of research on green energy, the global current situation and prospects in this direction justifies an analytical look at the terminology, system of indicators and methodology formed in this direction.

First of all, it is necessary to consider the concept of “renewable energy sources” (RES), which refers to green energy in a general context. Renewable energy is interpreted as the energy of renewable or inexhaustible energy resources on a human scale. It is also understood synonymously as “green energy” [6]. As the main principle of using such energy, it is associated with its receipt from processes constantly occurring in the environment and its technical application. Recover energy is extracted from natural resources—sources that are natural recovery, such as sunlight, wind currents, bumps, and geothermal heat. As statistics show, over the past two years, 26%-28% of global energy consumption has come from RESs, most of which—about 60%—comes from hydropower [9].

When we talk about renewable energy, our knowledge of its sources should also be expressed. RES contains energy sources that cannot be consumed by human use. The main principle here is the extraction of energy from processes occurring in the environment or renewable member resources and its provision for technical use. In many cases, alternative energy sources also act as RES. Nevertheless, these terms are not completely interchangeable. This is due to the fact that a number of alternative energy sources are based on limited resources. Alternative energy sources include wind energy, solar energy, alternative hydropower, geothermal energy, hydrogen energy, bioenergy, distributed energy generation, space energy, etc. [10]. RESs are all alternative energy sources. Alternative energy sources include a number of non-conventional

non-RESs in addition to RES. Solar, wind and atmospheric water energy, which are the main part of RES, are also called climate resources. The application of new technologies in the use of RES is expanding rapidly [11].

An important feature of electric power is the inability of its product—that is, electricity—to accumulate for further use. The production of electricity must correspond to the dimensions of consumption at each moment of time, taking into account the needs of the power plant itself and losses in the network [5]. Therefore, electric power has the characteristics of stability, permanence, continuity and immediate implementation.

The assimilation of alternative energy sources, especially their possible active assimilation, is imperative. This is due to the fact that human civilization is faced with the problem of global warming. The essence here is that carbon dioxide—CO₂, released in the process of obtaining electrical and thermal energy during the burning of coal, oil and gas, as well as in the process of ensuring the operation of vehicles of gasoline and diesel fuel, affects the heat exchange of the planet with the surrounding space, resulting in a greenhouse effect, accompanied by climate changes [4, 12].

When we pay attention to such terminologies as green energy and green energy circulating in this circle, we can see that green energy has become a real trend in the last decade. His mission is to save many countries from hydrocarbon dependence. “Green energy” is part of an energy generation system that uses RES. In this regard, it is also considered regenerative or renewable energy. Specifically, green energy refers to obtaining energy without polluting the environment.

Green energy basically incorporates the six most common forms. This includes solar energy, wind power, hydropower, geothermal energy, biomass and biofuels. Green energy is of paramount importance. This materiality is, as in the entire RES system, an essential condition for the environment. It replaces the negative

impact of fossil fuels with cleaner alternatives. Green energy from natural resources is renewable and clean. That is, at this time, little or no greenhouse gases are emitted. Green energy sources also differ in their inexhaustibility parameters. Looking at solar energy alone, we see that about 173 PW (1,015 W) of solar energy enters the Earth’s surface every year, which is 10 thousand times more than our planet needs. Green energy has both economic, financial and anti-crisis effects. It leads to stable energy prices. Its turnover is not affected by price increases or supply chain disruptions. It creates new jobs and strengthens employment. Statistics show that over the past 2 years, about 20 million jobs have been created worldwide with its facilities [13, 14]. Due to its focus on local supply, its global impact is also less, and its widespread use does not lead to such geopolitical crises. Thus, due to the local nature of energy production, its energy infrastructure becomes more flexible. It makes it more attractive for less dependence on centralized resources, which can lead to interruptions.

While emphasizing the quality and importance of green energy, its problematic aspects should also be considered. Both the accumulated experience and expert opinions make it possible to list them. First of all, it is shown that the cost of transferring green energy is large. So, depending on the distance of production, there must be a separate infrastructure for its implementation. The costs in the disposal of solar cells, wind installations and also energy storage devices are huge. On the other hand, we must also know that renewable energy cannot directly replace many of the devices and processes that exist today. So, today we cannot produce wind turbines, solar panels or build hydroelectric power plants without fossil fuel. To reasonably achieve this, at least 20 years of excavation fuel systems will be needed [14]. There are a number of other lenses that we cannot currently do with renewable energy alone. In this list, we can cite steel, cement, asphalt, fertilizer, plastic, etc. All this suggests that a complete transition to the era of green energy will

take at least half a century. On the other hand, extensive approbation of this type of energy must also be experienced.

Like other energy measurements, “Green Energy” has a methodological system and has indicators and indices characterizing its quantity and quality. Its important indicator is the configuration of structural elements, the ratio capacity in the national power generation capacity and the share of demand per capita. Like other indicators in the formation, electricity per household, the energy requirement required for a household to prepare food, the hot water requirement of a household, etc. can be shown.

There is also a need to enrich our views on “Green Energy” with the concepts of “Sustainable Energy”, “Green Economy” and “Green Growth”.

Sustainable energy is interpreted as energy that meets current needs without compromising its ability to meet the needs of future generations. Most definitions and designations of sustainable energy include consideration of social and economic aspects such as environmental and energy poverty, such as greenhouse gas emissions. Sustainable energy as a real component of sustainable energy is expressed as an energy supply developed from environmentally friendly sources and using environmentally friendly technologies. It involves the intelligent and responsible use of energy carriers. This concept applies to the entire process, starting with the production of energy and ending with its use by the final energy consumer [13].

The green economy finds an interpretation of economic science as a direction formed at the end of the twentieth century, which is considered as a dependent component of the economy from the natural environment. The concept of a green economy includes many other directions of Economic Science and philosophy—feminist economics, postmodernism, resource-oriented economics, ecological economics, environmental economics, anti-growth, anti-consumption, antiglobalism, green anarchism, green politics, the theory of international relations, etc.

includes ideas of plots. The theory of green economy is based on three axioms—it is impossible to infinitely expand the sphere of influence in a limited space; it is impossible to demand the satisfaction of infinitely growing needs in conditions of limited resources; everything on the Earth’s surface is interconnected [15].

When we approach the green economy in a scientific methodological aspect, we see that metapredmetnic methodology is inherent in it. This is due to the fact that here science in certain integrations intersects with other scientific branches. Summarizing our views on the green economy, we will see that it is an economy that does not affect natural assets. The concept of green economy supports resource conservation and reduces negative impacts on nature; the conclusion here is that the concept of green energy also dominates at the core of the green economy.

An increase in the quality of life of a person is in relation to an increase in natural capital. This is called “Green Growth”. “Green Growth” is a model aimed at stimulating economic growth and development through investments and innovations that ensure the safety of natural capital. Green growth is a term that describes a hypothetical path of economic growth that is ecologically sustainable. Green growth strategies focus on social problems and justice issues, accelerating progress on the path to sustainable development as a result of the transition process to a green economy. The concept of green growth is based on the use of four principles: the principle of eco-efficiency (involves maximizing the beneficial properties of goods and services while minimizing the impact on the environment during the life cycle of the product); the principle of resource saving (involves making management decisions taking into account the need to protect natural resources); the rinsi; the intersectoral principle (implies the involvement of representatives of various sectors of society in the decision-making process) [13]. Proponents of green growth policies argue that a well-implemented green policy can enable employment in sectors such as renewable energy,

environmentally friendly agriculture or sustainable forestry.

The UN, the Organization for Economic Cooperation and Development, the World Bank have worked out green development strategies. The international intergovernmental organization Global Green Development Institute, headquartered in Seoul, South Korea, deals specifically with this issue [16, 17]. The term “Green Growth” is used to describe national or international strategies. The recovery of the economy after the COVID-19 recession is also referred to as the “Green Recovery”.

Various indicators are used to measure the use of resources in the economy. Meanwhile, domestic material consumption occupies a more diverse position. It is the domestic material consumption that the European Union uses to measure the performance of its resources. On the basis of this indicator, it is determined that some developed countries have achieved a relative or even absolute separation of material use from economic growth. However, internal material consumption does not take into account the change in the use of resources as a result of supply chains. Therefore, another indicative material trace is in circulation here [3, 10]. This indicator seeks to cover the use of resources from the beginning to the end of the production chain.

3. Green Energy Potential in World Power Engineering

In the modern world, 60% of electricity is generated by thermal power plants (USA, Russia, China, India, Japan, 70%-80%), 16% by hydroelectric power plants (Russia, China, Brazil, Canada, 50%-60%), 16% by nuclear power plants (USA and France 50%, China and Russia 20%), the rest about 8% by alternative energy sources (China, USA, 35%-50%, Germany, Spain 20%-24%) [3]. Currently, the process of depletion of hydrocarbon resources on a global scale continues. At the same time, the generation of large hydroelectric power plants is also declining. On the other hand, their

maintenance costs and environmental viability have increased, and the relevance of the prospect of building new ones has been limited. All this has further expanded the use of RES against the background of global warming, and the process of replacing the traditional linear economy with circular and green economies has intensified. At the same time, the world's leading energy powers have increased their efforts to optimize the use of affordable and profitable energy—nuclear energy, and to direct the most effective scientific solution to the problem of significant part of investments in the field. Of course, the process of searching for non-traditional energy carriers has accelerated and a large-scale transition to green energy has emerged. In this regard, currently, in conditions of high dependence of mankind on energy, the study of the possibilities of additional energy sources plays a very important role. What is understood is that traditional energy sources are of a depleting nature, they are expensive to use, and their harmful impact on the environment is great. And here one of the ways out is connected with a fundamental access to “Green Energy”.

The peculiarity of green energy sources is that they usually regenerate naturally, unlike fossil fuel sources such as natural gas or coal, which can take millions of years to recover. Also, their harm to the ecosystem in the chain of production and consumption is minimal.

Statistics show that the world's green energy potential has grown on average since 2000 by 3.2% per year. And the growth of traditional energy during this period was 2 times less, about 1.4% per year. Dynamics in individual sectors of energy production in RES has been extensive. In 2020, the growth share of green energy amounted to 6%. At present, in the modern world, when large hydroelectric power plants are excluded, the share of the use of alternative energy sources is within 8%. In this share, the sun is 55%, the wind is 28%, the biomass is 10% and the others are 7% in volume. This area is constantly invested, and its payback period takes 7-8 years [4].

Among the countries where the use of non-traditional energy is widespread, China, the USA, Brazil, India, the Federal Republic of Germany, Canada, Japan, France and Italy are at the forefront. Below is a table (Table 1) characterizing the potential of alternative energy sources in these countries.

It should be noted that state measures are being taken in Russia in the direction of “Green Energy”. Despite the course of the Russian-Ukrainian war, activities in the field of “Green Energy” continue in the country. Currently, the share of “Green Energy” in the country is about 2 per cent. According to the government plan, in 2024 this indicator is aimed at increasing to 5.4% [3].

Various measures to support green energy are being implemented in leading world countries. Within these, the following can be interpreted [2, 6, 13]:

- Green certificates (confirming the production of electricity in a certain volume based on renewable energy);
- Payment of the cost of technological connection (state authorities may provide for partial or full

compensation of the cost of connecting generators to the network in order to increase the investment attractiveness of projects based on renewable energy);

- Guaranteed tariffs (guarantee of receipt of generated electricity at the established price);
- Clean measurement system (the support measure provides for the possibility of measuring the electricity supplied to the network and using this quantity in mutual settlements with the power supply organization);
- Preferential tax and customs regimes (the application of tax incentives for renewable energy sources is based mainly on freedom, exceptions and benefits arising from various taxes, including the application of preferential customs duties);
- Investment incentives (the state’s provision of various financial support by means such as environmental tax incentives, value added tax exemptions and accelerated depreciation with low-interest and long-term lending to enterprises in the stages of renewable energy production and consumption).

Table 1 Alternative energy sources potential of countries.

Countries	Alternative energy potential (GW)	Characteristic features
China	1000.0	The country is dominated by Coal power plants, and in this regard, it exports the most CO ₂ emissions in the world. The largest plants for the production of panels necessary for the use of solar energy are located here. The country is one of the world leaders in the use of hydropower resources, and by 2040 it plans to produce “green” energy in the amount of 250 GW.
USA	325.0	The country is implementing a photoenergetic transformation program and is aimed at increasing its green energy to 65%. The potential for wind energy is very high, and the country is also a world leader in the development of geothermal energy. In the country, the temperature difference between the core and the crust of the Earth is also used in obtaining energy.
Brazil	160.0	It remains the country with the greatest wind power in South America.
India	147.2	It has the second highest wind energy capacity in Asia. It has the third largest wind farms on land in the world.
Germany	138.4	Alternative energy sources the share of electricity here is 47.3%. The country is the leader in Europe and 5th in the world in terms of investment in alternative energy (8-9 billion euros per year).
Canada	102.9	Canada’s capacity for alternative energy sources accounts for 17% of the country’s energy supply. Wind energy here has increased significantly over the past 10 years, reaching 6,201 MW.
Japan	111.8	After the explosion at the Fukushima Nuclear Power Plant, the government began to renew its energy sources.
France	59.5	It accounts for 3.3% of global solar energy production. This type of energy is mostly produced at small stations. It is planned to increase the power of these stations to 5.4 GW.
Italy	56.9	It remains one of the main producers of solar energy in the country where the total volume of solar production is 12.5%. With its help, 7% of the population is provided with electricity.

Source: Prepared by the author based on the materials of the International Energy Agency [3].

It should also be emphasized that over the past 10 years, investments in green energy have averaged 250-300 billion US dollars.

Looking at the development scenarios of the next two decades in the field of green energy, we can see that if there are no drastic strategic changes, the world's demand for energy carriers will increase by 20% in the next 45 years, with 87% of this growth coming from developing countries, more than half from the PRC and India. As a result, CO₂ emissions will also increase accordingly (by 2030 by about 40%-45%), which will be accompanied by a rise in the total temperature of the Earth to 6 °C. Three-quarters of CO₂ growth will come from China, India and the Middle East, with 97% from developing countries. In contrast to the world trend, only in Japan and the European Union will there be a decrease in the volume of waste [3, 10].

Development in the field of green energy in 2025-2030 will increase its share in energy consumption to 5.8%, and this share will be equal to the limit of 20% in the USA, Great Britain and other developed countries. In this scenario, it is predicted that the RES will create 2.8 million new jobs and provide 1.1% growth in global GDP (gross domestic product). Also, the global energy balance will change, as domestic fuel-powered motor transport, which consumes twice as much energy as energy produced at all power plants, will give way to electric cars. In addition, the transformation of finished oil fields into energy farms with the aim of obtaining ethanol will be expanded. In addition, a major transition to hydrogen-based energy will take place, and the idea of installing solar power plants in space (an orbiting solar power plant accumulates energy and transfers it to Earth using microwave radiation or a laser stream) will also come true [9].

4. Green Energy and RES Potential in Azerbaijan

Electric power is the main factor and necessary condition for the development of the population and

other spheres of society as the main sector of the economy of Azerbaijan. Its industrial age in Azerbaijan has exceeded 130 years. The electric power industry in the country began to develop in the 1890s—with the production of 9 billion kV of electricity. A major breakthrough in the field has taken place since 1950. At present, an average of 26-27 trillion kV of electricity is generated annually in the world. This volume is 5 times higher than the production of 1970, 2.3 times higher than the production of 1990 and 1.3 times higher than the production of 2010; 94.5% of generated electricity accounted for thermal power plants, 4.1% for hydroelectric power plants and 1.4% for RES with a volume exceeding 100 MW [18, 19].

Using its natural energy resources effectively, Azerbaijan has ensured its security in the field of power engineering and is developing it continuously and steadily. As a result, over the past 20 years, the country's electricity system has been further strengthened and its investment capacity has been increased to 7.2 thousand MW. However, it should be noted that Azerbaijan has secured infrastructure facilities for the transmission of electricity to all regional states except Armenia, and it has been exchanging electricity with Turkey, Russia, Iran and Georgia for several years now [20].

In ensuring the safety of electricity in the country, RESs—wind, solar, biomass, etc. are used. Special importance is also attached to the expansion of use. To this end, a new regulatory framework is being formed, foreign cooperation is being expanded, directives of new development goals are being implemented. All this fundamentally conditioned a new stage of reforms in the electric power sector and served as the basis for the formation of an appropriate strategy for Sustainable National Energy Security.

According to the latest estimates, the economically viable and technically usable RES potential in the country is estimated at about 27 thousand MW, including solar energy at 23 thousand MW, wind energy at 3 thousand MW, bioenergy potential at 400

MW, mountain rivers potential at more than 500 MW. Adding to this the 157 GW wind power community calculated in the Azerbaijan water area of the Caspian Sea, there is an even greater potential [7, 20]. It should be noted that the use of this potential of the Caspian Sea occupies an important place in the country's "Green Energy" policy. In the future, this potential will provide a large-scale export of electricity from the country, as well as the national economy will receive added value through the production of "Green Hydrogen" here.

Currently, the level of use of the existing RES potential in the country is 1.2% in the energy balance. An average of about 400 million kV of electricity is generated here every year [20]. Over the past 15-20 years, numerous solar and wind power plants have been built in the Republic, the capital Baku and the regions, and solar panels have been installed in a number of schools and medical centers, highways and households. The expansion of the use of RES makes it possible to save large volumes of gas fuel at the country's thermal power plants. The gas volumes obtained here create the basis for meeting the needs of other sectors of the economy or increasing the country's export potential.

Azerbaijan is constantly expanding the use of green energy. Currently, "ACWA Power" Company of the Kingdom of Saudi Arabia is building a 240 MW wind farm in Absheron and Khizi regions, and "Masdar" company of the United Arab Emirates is building a 230 MW solar plant in Garadagh district in Baku. In addition, the construction of "Khudaferin" with a total capacity of 200 MW (100 MW for each of the Azerbaijani and Iranian sides), "Maiden" Tower with a capacity of 80 MW (40 MW for each of the Azerbaijani and Iranian sides) and Ordubad hydroelectric power plants with a capacity of 36 MW are continuing on the Araz River [7].

In 2021, the volume of electricity generated at the expense of RES in the country was 339.2 million kV, of which 91.5 million kV were wind, 55.2 million kV were solar, and the remaining 193.2 million kV were bioenergy sources. In addition, 34.3 million kilowatt-

hours of electricity was produced by the non-state sector at the expense of renewable energy sources, of which 59.8% came from wind power plants and 40.2% from other sources.

Also, a solar power plant with a capacity of 3 MW was put into operation in Kangarli District of Nakhchivan Autonomous Republic, and with it, taking into account hydroelectric power plants, 40% of the electricity demand in the autonomous republic is provided at the expense of RES [18, 19].

These measures have had a very important impact on improving the supply of electricity to the population and economy, and in general, after 2003, as a result of the reforms carried out in the field of electric power, Azerbaijan has turned from an importer to an exporter of electricity. Now, every year, an average of 1-1.5 billion kV of electricity is exported from the country to Turkey, and from there to European markets. Export geography has already covered Romania and Hungary [7, 20]. Over the past period, new normative-legal acts were adopted in the direction of general development of the sphere, including simplification of legal procedures, ensuring transparency and consumer satisfaction, and the legislative framework was improved.

The liberated Karabakh and East Zangazur economic regions of Azerbaijan also have large green energy resources. The construction of thermal power plants on these occupied lands has not been implemented for a long time. And now there is no particular need for it yet. This is because the great green energy potential of this place draws such an approach to the background. In this regard, it is emphasized once again that the president of the Republic of Azerbaijan Mr. Ilham Aliyev declared the Karabakh and East Zangazur economic regions as a Green Energy Zone and instructions were given here to build an energy system that meets the most modern standards.

According to preliminary estimates, these areas have a potential of about 7,200 MW of solar and about 2,000 MW of wind energy. The energy capacity of the rivers

here is also highly valued. According to preliminary data, there are about 30 hydroelectric power plants here. But most of them have been rendered useless. At present, several stations have been restored here and new ones are under construction.

The following table (Table 2) presents information about existing and designed hydroelectric power plants in Karabakh and East Zangazur economic regions.

Speaking at the International Conference on “South

Caucasus: development and Cooperation” held at ADA University in April last year, President of the Republic of Azerbaijan Ilham Aliyev said: “We are currently at the final stage of negotiations with BP for solar and wind energy in Karabakh. About 240 megawatt solar power plants in Jabrayil, as well as about 100 megawatt wind power plants in Kalbajar with international companies—in addition, starting in January this year, two important events, a groundbreaking ceremony took

Table 2 Karabakh and Eastern Zangezur economic regions existing and projected hydro power stations.

No.	Hydroelectric power stations	Economic district	Water basin	Power (MW)	Production capacity, (mln. kWh)
Commissioned Hydroelectric Power Stations					
1	Fuzuli	Garabagh	Main shaft channel	25	70.0
2	Gulabird	East Zangazur	Hakari River	8.0	20.0
3	Sugovushan-1	Garabagh	Tartar River	4.8	13.4
4	Sugovushan-2		3.0	7.0	
5	Kalbajar-1	East Zangazur	Lev River	4.4	12.3
Total				45.2	122.7
Hydroelectric Power Plants under construction					
1	Khudaferin	East Zangazur	Araz River	100*	250.0*
2	Maiden Tower			40*	110.0*
3	Qamishli		Lev River	6.3	17.0
4	Square		Meydan River	3.4	9.5
5	Soyuzbulag		Tartar River	5.3	14.0
6	Chiraq-1			8.3	21.0
7	Chiraq-2			3.6	10.0
8	Shayfli		Okhchuchay River	10.5	33.8
9	Sarıqışlak			10.5	33.1
10	Zangilan			10.5	32.3
11	Jahangirbeyli			10.5	31.6
12	Zar		Zar River	3.78	10.8
13	Agbulag		Hochazsu River	14.25	49.9
14	Mishni			8.24	28.8
15	Mirik			3.2	10.2
16	Qarıqışlak			3.8	12.1
17	Sheylanli			4.3	13.7
18	Alkhasli			6.0	19.2
19	Kalbajar-2			Lev River	1.0
20	Nadirkhanli		Tartar River	8.2	26.1
21	Upper Vang			12.5	40.0
22	Low Vang			19.5	62.4
23	Toganali		Kurekchay River	4.6	17.8
Total				298.27	856.5
Conclusion: 28 power plant				343.47	979.2

Source: prepared by the author on the basis of materials of “Azerenergy” OJSC [19].

* To the share of Azerbaijan.

place: to build a solar and wind power plant with a total capacity of 470 megawatt. One is by the leading company of Saudi Arabia in this area ‘ACWA Power’, the other project is by the UAE company ‘Masdar’. This is really a great contribution to our energy system, a great demonstration of the attractiveness of Azerbaijan” [20].

Diversification of various energy sources in the structure of energy production, in particular, the steady increase in the share of green energy, requires an adequate perspective on the energy balance and an appropriate strategic line of development. From this point of view, it is considered appropriate to take appropriate measures to ensure the balance of the potential of green energy in the regions of the Republic of Azerbaijan and the expansion of its use.

5. Result

Our analysis and assessment of the global goals in the field of green energy and the associated realities of Azerbaijan lead us to conclude that the world energy is in a stage of great transformation and is entering a new era of quantitative and qualitative supply and demand based on more environmentally sustainable development. Resource constraint brings corrections to the energy concept and national security strategies of industrial states in the context of new global challenges. Energetic development is painted green. This conceptual direction is no exception for Azerbaijan. Therefore, the energy policy pursued in the country is improving and more optimal in the context of green energy. In this regard, based on the current realities and the analysis carried out, the following are characterized as imperatives of the green energy strategy in Azerbaijan:

- continuing the overall energy strategy in a more formal format, argumentative and dialectical view, based on sustainable strengthening of National Energy Security, efficient use of green energy resources;
- determination of configurative regional green energy potential for each algorithmically calculated

energy source in accordance with current requirements and prospects and preparation of relevant cadastre;

- development of an appropriate investment-backed state programme in line with the regional green energy strategy and implementation of stimulating mechanisms across one energy zone;
- increasing energy efficiency, formation of a more modern optimal energy system and infrastructure based on green energy in line with growing population needs;
- programmatically expanding the use of solar panels and collectors in households, administrative and apartment buildings, private houses, creation of regional (especially in large cities) solid waste plants;
- supply of one or more adjacent villages with RES based on solar, wind and biofuel use (hybrid or separate);
- expanding the use of high technologies, including National Space services (satellite services) in the management of green energy infrastructure;
- regular study and maintenance of advanced international experience in the wide application of green energy, expansion of institutionalization, continuous improvement of the regulatory framework in the field;
- in accordance with the principles of environmental efficiency and emission economy, increasing decarbonization activities, expanding the use of electric cars and building a comparable infrastructure, broad implementation of artificial intelligence resources and “Industry-4” achievements in the energy sector;
- consolidation of energy resources in the liberated lands, transformation of the region into a fundamentally and continuously developing green energy zone with the use of modern technologies and the establishment of an innovative energy system that meets the most modern standards.

In connection with the widespread use of green energy in the Republic, it is considered necessary to technically and economically adapt existing and newly created wind and solar generating capacities to the

consumption schedule of the Republic in order to eliminate its negative effects on the electric power system.

The realities are such that Azerbaijan, based on national interests, takes into account all trends in its energy strategy in line with new global challenges, consolidates its historical role as an important oil country at the level of modern requirements and defines, improves and regulates new goals of development in the energy sector in line with economic progress and economic diversification.

References

- [1] Schwab, K. 2020. *The Fourth Industrial Revolution*. Baku: University of Economics, p. 200.
- [2] Sidorovic, V. 2019. *Mirovaya enerqeticeskaya revolyuciya: Kak vozobnovlyaemiye istocniki enerqiy izmenyaet nas mir*. Moskva: Alpina Publisher, p. 208. (in Slovenian).
- [3] Official Website of International Energy Agency. 2023. <https://www.iea.org>.
- [4] Zerkalov, D. V. 2012. *Enerqeticeskaya bezopasnost*. Kiyev: Osnova, p. 920.
- [5] Ceferov, T. Q. 2015. *Energy—By Being, on the Verge of Non-existence*. Baku: Serq-Qerb, p. 136.
- [6] Qermanovic, V. 2014. *Alternativniye istocniki enerqii i enerqosberejениye. Prakticeskiye konstrukciy po ispolzovaniyu enerqii vetra, solnca, vodi, zemli, biomassi*. Sankt-Peterburg: Nauka i Texnika, p. 320. (in Turkish)
- [7] Official Website of the President of the Republic of Azerbaijan. 2023. <https://www.president.az>
- [8] Ministry of Justice of the Republic of Azerbaijan. 2023. “Unified Electronic Database of Legal Acts.” <https://www.e-qanun.az>.
- [9] Official Website of International Renewable Energy Agency (IRENA). 2023. <https://www.irena.org>.
- [10] The Site of Professor Elshan Hajizadeh. 2023. <https://www.hajizada.com>.
- [11] Hajizadeh, E. M. 2018. *World Economy and Azerbaijan*. Baku: Letterpress, p. 912.
- [12] Gates, B. 2021. *How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need*. Moskva: Mann, İvanov i Ferber (MİF), p. 336.
- [13] Cekson, T. 2013. *Procvetaniya bez rosta: osnovi ekonomiki zavtraşnevo*. Moskva: AST-Press, p. 304. (in Bosnian)
- [14] Allan, B. B., and Meckling, J. “Creative Learning and Policy Ideas: The Global Rise of Green Growth. Forthcoming in *Perspectives on Politics*.” https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3765002.
- [15] Qasımlı, V. E. 2022. *Green Economy*. Baku: Azprint, p. 280.
- [16] United Nations Organization. 2023. <https://www.un.org/ru/>.
- [17] Official Website of Organisation for Economic Co-operation and Development (OECD). 2023. <https://www.oecd.org>.
- [18] Azerbaijan Republic Ministry of Economy. 2023. <https://www.economy.gov.az>.
- [19] “Azerenergy” OJC. 2023. <https://www.azerenerji.com>.
- [20] Ministry of Energy of Azerbaijan Republic. 2023. <https://www.minenergy.gov.az>.