Uzbek Scholar Journal
Volume- 24, January, 2024
www.uzbekscholar.com

GLOBAL POLICY IN THE FIELD OF NON-TRADITIONAL AND RENEWABLE ENERGY SOURCES. DYNAMICS OF ENERGY CONSUMPTION

Uktam Dekhkonovich Sherkulov
NavGPI

Abstract

Humanity needs energy, and the need for it is increasing every year. At the same time, the reserves of traditional natural fuels (oil, coal, gas, etc.) are finite, according to the results of numerous studies, organic fuels by 2023 can only partially meet the demands of the global energy sector. There are also limited reserves of nuclear fuel – uranium and thorium, from which plutonium can be obtained in breeder reactors. There are practically inexhaustible reserves of thermonuclear fuel – hydrogen, however, controlled thermonuclear reactions have not yet been mastered and it is unknown when they will be used for industrial production of pure energy, i.e. without the participation of fission reactors in this process.

There are two ways left: resource conservation and the use of non-traditional renewable energy sources. The term "renewable energy sources" is applied to those energy sources whose reserves are replenished naturally and are practically inexhaustible in the foreseeable future. Depending on the technologies used, renewable energy sources (RES) are divided into traditional and non-traditional. Traditional renewable energy sources include hydraulic energy converted into electricity at large hydroelectric power plants, as well as biomass energy (firewood, dung, straw, etc. P.), used to generate heat by the traditional method of combustion. The group of non-traditional renewable energy sources includes solar and geothermal energy, wind and sea wave energy, currents, tides, hydraulic energy converted into electricity at small hydroelectric power plants (up to 10 MW), and biomass energy used to produce heat, electricity and motor fuel using non-traditional methods [1].

In addition, energy is one of the main pollutants of the air and the environment. Power plants running on traditional fuels contribute up to 30% of the volume of harmful atmospheric emissions, pollute land and water with combustion products and wastewater. The gases released are largely associated with the greenhouse effect, the catastrophic consequences of which the world community is trying to prevent today through the mechanisms of the Kyoto Protocol.

The political, economic and environmental crises that have occurred in the world in recent years have potentially affected the energy security of countries and regions. Examples of such crises are the 1973 oil crisis, terrorist attacks in the United States, disruptions in gas transit to EU countries through Ukraine, accidents at the Chernobyl nuclear power plant in 1986 and the Japanese Fukushima-1 nuclear power plant in 2011 and other similar events. As a result of such events, humanity realized that it is irreversibly dependent on renewable energy sources and the dangers of some of them.

The situation in the field of alternative and renewable energy in Europe and the United States has developed along its own path. In Western countries and in the United States, research has begun in the field of alternative energy production, their strategic goal has become to ensure national energy security. The work of scientists was carried out on various types of alternative sources, the only obvious limiting factor was the natural and climatic conditions of specific territories [2]. According to the data provided by Nezavisimaya Gazeta, the share of renewable energy sources (including small hydropower) in the world has increased slightly over 30 years: from 13.3% in 1970 to 13.6% in 2000[2].

Since the beginning of the XXI century, alternative energy abroad has received another wave of investments. The European Union has begun to create a pan-European electricity distribution system using AE, the United States has announced plans to increase the share of alternative energy sources in its energy mix to 20% by 2020. The European Union also plans to increase the share of alternative energy sources in its energy mix to 40% in 2040. Germany planned to get rid of nuclear power plants by 2023, and to increase the share of alternative energy to 35% by that time. In Thailand, the authorities have frozen five nuclear power plant construction projects. Switzerland has suspended its nuclear program[3].

Similar research and work has been carried out in other leading countries of the world: Russia, China, India and others. Later, the goal was put forward to create an international organization to develop cooperation in this area between the communities of the world, and this issue was first raised in 1981 in Nairobi at the UN Conference on new and renewable energy sources. Subsequently, the creation of such an organization was lobbied by the largest renewable energy companies, in particular Eurosolar.

Since then, the interest of international organizations has only increased and several major conferences have been held at the interstate level, where the importance of renewable energy sources and prospects for their development were discussed:

- The World Summit for Sustainable Development in Johannesburg in 2002 (The World Summit for Sustainable Development 2002 in Johannesburg (WSSD));
- The International Renewable Energy Conference in Bonn in 2004 (The 2004 Bonn International Renewable Energy Conference);
- G8 Summit, Gleneagles, Scotland (UK), 2005 (The G-8 Gleneagles Dialogue);
- The International Renewable Energy Conference in Beijing in 2005 (The 2005 Beijing International Renewable Energy Conference).

It is worth noting that it was at the conference in Bonn that the final decision was made on the need to create the International Renewable Energy Agency (IRENA) [4].

By the end of 2023, 169 countries (not including the EU28 countries) had become members of this organization, and at the moment 11 countries have applied to join this organization [5].

As a result of the stimulating orientation of producers and interested organizations to achieve this direction of energy in all interested countries of the world through the adoption of historical laws and decisions at the level of public administration, there has been a shift in the field of renewable energy sources. This was made possible by a combination of interventions:

-use of legislation and submission to the tariff (FiT), if any;
-tax incentives for the import and development of technologies;
-promotion in the field of commercial technology;
-newer forms of commercial structuring and financing methods, such as green bond financing.

Over the years, projects offering energy from renewable sources have become reliable low-carbon alternatives to carbon-based, fossil fuel-based projects.

The global commitment to climate change mitigation in line with the Paris Agreement in 2015 also helped reduce the short-term effects of low oil prices by recognizing
the long-term benefits of using renewable energy sources. The Paris Agreement has already received documents of ratification, acceptance, approval or accession from more than 55 countries, which are cumulatively responsible for 55% of global greenhouse gas (GHG) emissions. It is expected that this will become a catalyst for renewable energy projects.

In 2015, the UN General Assembly adopted the Sustainable Development Initiative for Sustainable Energy Development for All (SDG 7). Around the same time, the G7 and the G20 groups of countries committed to accelerate renewable energy and energy efficiency programs, respectively.

Renewable energy policies have evolved – especially for electricity, heating and cooling, transportation, and government initiatives. Many countries now clearly understand the benefits of using renewable energy sources as a source of meeting off-grid and distributed demand.

Since 2014, the number of countries with renewable energy targets and policies has increased, and several jurisdictions have made their existing goals more ambitious – including an increased number of countries that have set themselves the goal of switching to 100% electricity generation through renewable energy sources. More than 170 countries have renewable energy targets, and an estimated 150 countries have policies that support renewable energy sources.

The expansion of the use of renewable sources of electric energy has become possible due to technological progress in this area, which has made it possible, first of all, to significantly reduce the cost of electricity production by wind and solar power plants of various types. The cost of new SES in the world has decreased by 60% since 2010, and wind farms by 40% [6.10].

As a result of the reduction in the cost of technologies and the strengthening of the environmental agenda, the development of renewable energy has accelerated since 2010, reaching record levels and outstripping the annual commissioning of traditional capacities in many regions. Since 2012, more than half of the increase in generating capacity in the world has been accounted for by renewable energy facilities. In 2020, their share in the growth of global electric power capacity reached 65% [6, 8]. This means that for every additional megawatt of fossil fuel generating capacity, renewable energy was responsible for two.

At the beginning of 2020, the installed capacity of renewable energy generating stations in the world amounted to 1,347 Kw (excluding hydroelectric power plants). Renewable generation capacity increased by 176 kW (+ 7.4%) in 2020. Solar energy continued to develop, increasing by 98 GW (+ 20%), followed by wind energy with 59 GW (+ 10%). Hydropower capacity increased by 12 GW (+ 1%), and bioenergy – by 6 GW (+ 5%). Geothermal energy has increased to just under 700 MW. Solar and wind energy continued to dominate the expansion of renewable capacities, which accounted for 90% of all inputs in 2020[6, 10].

Among all renewable energy technologies, wind power after hydropower has dominated the renewable energy industry for many decades. Since 2000, the wind energy industry has developed with a cumulative average annual growth rate (hereinafter referred to as the PP) of more than 21%. In the early years of wind energy deployment, Europe was a key region for global wind farm withdrawals. In 2010, the region accounted for 47% of the world's land-based wind installations. After 2010, the rapid development of wind energy has been observed in other regions, especially in China, where the GTR indicator is about 27%. By 2018, China had surpassed Europe to become the largest onshore wind energy market with almost one third of the installed capacity in the world. In 2020, almost $30 billion was invested in new wind farms. At the same time, the unit costs for onshore wind energy averaged $1.54 million per MW, and for offshore – $2.57 million per MW [6, 10].

At the end of 2020, the total installed capacity of onshore wind energy reached 773 GW, and at the end of 2019 621 GW [6, 8]. The top five countries as of 01/17/2021 include such countries as China (installed capacity of the WPP 80 GW), the USA (60 GW), Germany (30 GW), Spain (23 GW), India (20 GW) [6, 11].

As of 2020, the total capacity of offshore wind projects worldwide that are in operation, under construction, coordinated, planned or under development currently stands at 197.4 GW. About half of this amount (50.5%) is accounted for in Europe (99.6 GW). The UK retains the leadership here with its 41.3 GW of such capacity. China jumped from fourth place to second, increasing plans by 80% – from 14.5 GW to 26.1 GW. The USA retains the third place with an increase of 10% (from 16.2 kW to 17.8 GW).

Brazil in the ranking appeared out of nowhere to immediately take fourth place with 16.3 GW. All of its 10 offshore wind projects were announced during 2020. Taiwan remains in fifth place with a 65% increase from 9.2 GW to 15.2 GW [6, 9].

Over the past two decades, photovoltaics has evolved from a niche market product into one of the main sources of electricity production. The dynamics of growth is becoming less dependent on government incentive programs and is more determined by market investment decisions.

By the end of 2020, the global installed capacity of solar photovoltaic power reached 627 GW with a cumulative annual growth rate of almost 43% since 2000, and it remains the second largest installed capacity sector of renewable energy after wind energy. In 2020, solar photovoltaic systems again dominated the total volume of renewable energy capacity with capacity inputs of about 115 GW, which is twice as much as wind and more than all fossil fuels and nuclear fuels together [6, 9].

Currently, the top five leaders in the use of solar energy include Germany (installed capacity of 35.3 GW), China (19.9 GW), Italy (17.5 GW), Japan (13.5 GW), the USA (12.2 GW) [6, 12].

In more than 10 years since 2009, $3.07 trillion has been invested in green energy worldwide. of these, more than $1 trillion. – in the last three years. Investments are mainly used for the development of renewable energy (including bioenergy production) and smart energy-efficient technologies [6, 9].

"If we want to prevent a climate catastrophe, renewable energy sources represent the only reliable way forward. Today, their share in global electricity production is about 30 percent. By 2030, this figure should rise to 60 percent, and by 2050 to 90 percent. And this is possible if we act now," United Nations Secretary—General Antonio Guterres said in a video message.

He called for removing international patent barriers to renewable technologies, expanding access to materials and components for renewable technologies, switching subsidies from fossil fuels to clean energy, and increasing private investment in renewable energy sources worth $4 trillion. per year.

In 2022, 81% of all installed new energy capacities were accounted for by renewable energy sources [13].

Global investments in the "low-carbon energy transition" in 2023 amounted to 1.77 trillion US dollars. This is a new record, which is 17% higher than in 2022.

China remains the largest investor in the energy transition. In 2023, it invested $676 billion, which is equivalent to 38% of the global investment volume. Although China remains the dominant player, its gap with rivals has narrowed as investment in the United States and the European Union has grown at a faster pace. Nevertheless, as we have repeatedly noted, it is the BRICS countries (China, first of all, of course) that are the leaders of the energy transition today. In terms of investment volumes, they are ahead of the United States and the EU combined. In many other parameters (for example, installed capacity and renewable energy generation), the same is true [15].

According to information published by the Electric Power Council of China (CEC), the installed capacity of solar energy in China in 2024 will reach 780 gigawatts (GW), and wind energy 530 GW.

The total installed capacity of variable renewable energy sources — solar and wind energy — in China amounted to more than 1,050 GW by the end of the past 2023. The installed capacity of solar energy amounted to 609.49 GW, an increase of 55.2%. The largest growth occurred in China, which commissioned as many solar photovoltaic installations in 2023 as the whole world in 2022, while the growth of wind energy in China increased by 66% year-on-year. The increase in renewable energy capacity in Europe, the United States and Brazil has also reached unprecedented heights [14, 16].

Investments in the United States jumped by 22% year—on-year to $303 billion - the effect of the Inflation Reduction Act (IRA) began to be felt.

Investments in production facilities for the production of "clean energy technologies" have grown to $135 billion worldwide in 2023 and may grow to $259 billion by 2025 [15].

The state of renewable energy sources (RES) in the Republic of Uzbekistan in recent years. The Republic of Uzbekistan has a fairly high technical potential for renewable energy, namely, energy production from solar generation can range from 525 to 760 billion kWh, wind generation of more than 1 billion kWh, biomass energy up to 6 billion cubic meters of biomethane per year [17]. Photovoltaic plants have particularly great prospects in Uzbekistan due to the fact that about 320 days a year are sunny in the country.

The assessment of the results of the intensity of solar radiation shows an almost uniform distribution of solar potential across the territory of Uzbekistan [18].

Table 1.

	Regions	**Σq, кВт час/м²**	**n, час.**
1.	The North of the Republic	1900-2100	2900-3000
2.	((Republic of Karakalpakistan, Khorezm viloyat and north of Navoi viloyat)	1900-1960	2950-3050
3.	South of the Republic	1500-1550	2650-2700
4.	((Kashkadarya and Surkhandarya viloyats)	1910-1980	2930-3000
5.	Ferghana Valley	1943	2852

The Republic of Uzbekistan has significant wind energy resources suitable for the development of commercially successful large-scale wind farms. The total technical potential is estimated at more than one million GWh of electricity or 520 MW of installed capacity [18].

In the period up to 2030, Uzbekistan faces a number of national tasks [19], in particular, to ensure universal access to cheap, reliable and modern energy supplies by 2030, to seriously increase the share of energy from renewable sources in the energy balance of the world, to double the indicator for strengthening energy efficiency, modernity and tasks for expanding infrastructure and modernizing technologies have been identified ensuring sustainable energy.

The total potential of Uzbekistan for renewable energy sources is 117.984 million tons of natural gas, its technical potential is 179.3 million tons of natural gas (so-called tons of oil equivalent). The main share of this potential is solar energy, and its gross potential is 50.973 million tons.e. and the technical potential is 177 million tons.e. The technical potential of solar energy is 3-3.5 times higher than the consumption of primary energy in our country. The favorable climatic and geographical location of our

country makes it possible to use the potential of solar energy on a large scale for industrial purposes. The total potential of wind energy is 2.2 million tons per year, of which there is a possibility of technical use of 19%. The total potential of geothermal energy exceeds the potential of solar energy, its volume is 67 billion tons per year. Due to the lack of development of simple and economically useful technologies for the utilization of this type of energy, 0.3 million tons per year is technically possible to purchase only a part (Table 2). There is also the potential for biogas production by recycling household waste in various sectors of the economy, in particular in industry and agriculture. At the same time, the introduction of optimal technologies makes it possible to obtain 250 m3 of biogas from one ton of solid waste.

The potential of renewable energy sources in Uzbekistan*

Table 2.

Renewable energy sources	**Gross potential**	Technical potential
Hydropower	9.2 million t.n.e	2 million t.n.e
Wind energy	2.2 million t.n.e	0.4 million t.n.e
Solar energy	50973 million t.n.e	177 million t.n.e
Total renewable energy sources (excluding geothermal energy sources)	50984 million t.n.e	179 million t.n.e
Geothermal energy	67,000 million t.n.e	0.3 million t.n.e
Common renewable energy sources	117984 million t.n.e.	179.3 million t.n.e.

*Source: [21].

The Development Strategy of Uzbekistan has been adopted – an action strategy for five priority areas of development for 2017-2021. At the end of January 2022 The Development Strategy of the New Uzbekistan for the period 2022-2026 has been adopted. In the new Strategy, specific attention is paid to the development of renewable energy sources and the development of projects for the transition to a "green" economy [23]. In 2019, the Law "On Renewable Energy Sources" was adopted, which defines state support for the renewable energy sector [24]. Prior to this law, the legal side in this area was mainly represented by high-level decisions to promote the use of renewable energy [25]. The Republican Commission on Energy Efficiency and Renewable Energy Development has been established under the Ministry of Economy of the Republic of Uzbekistan. The International Institute of Solar Energy in Tashkent, established in 2012 with the support of the ADB, has received significant powers to study the possibility of using renewable energy sources and developing technologies. The target parameters for the development of the renewable energy sector and the stimulation of the renewable energy sector have been determined. A number of adopted documents contribute to the wider use of renewable energy: Decree of the President of the Republic of Uzbekistan "On measures for the further development of alternative energy sources" dated March 1, 2013, Decree of the President of the Republic of Uzbekistan "On the Program of measures to reduce energy consumption, the introduction of energy-saving technologies in industry and the social sphere for 2015-2019" dated May 5, 2015, Decree of the Government of the Republic of Uzbekistan "On measures for the further development of renewable energy, energy efficiency in the economic and social sectors for 2017-2021" [26].

In recent years, the use of renewable energy sources has been increasing in our country. In particular, in 2016, the total renewable energy capacity amounted to 2.709 million tons of oil equivalent, and in 2018 this figure reached 2,802 million tons of oil equivalent [20].

The total capacity of renewable energy sources increased by a total of 403 MW in 2000-2018 and reached 1999 MW in 2018. The share of renewable energy sources in the country's energy balance was 3% [22].

In 2021, the first 100 MW SES was built and commissioned by one of the leading international renewable energy development companies in the world - Masdar company in the Karmaninsky district of Navoi region.

In 2021, an industrial solar photovoltaic plant with a capacity of 100 MW was launched in the Samarkand region, which will generate 252 million kWh/year.

Also, the construction of two 200 MW SES in the Samarkand and Jizzakh regions, the Sherabad district of Surkhandarya region, a 200 MW SES and a 220 kV substation and a 52 km long power transmission line is continuing.

The construction of wind farms with a total capacity of 500 MW near Zarafshan is continuing, with the expansion of capacity to 1.5 GW with the participation of Masdar.

Saudi company ACWA Power will build the largest wind farm in Central Asia with a capacity of 1.5 GW in Karakalpakstan. Currently, the company is implementing a number of energy projects, in particular, the construction of two 500 MW wind farms in the Bukhara region and another one in Karakalpakstan with a capacity of 100 MW.

According to the Concept of development of the hydropower industry of the Republic of Uzbekistan for 2020-2024, by 2025 it is planned to commission 4 HPPs with a capacity of more than 30 MW and 16 small HPPs with a capacity of up to 30 MW. The total cost of all projects will exceed $2.68 billion, including $2 billion of own and $643 million of loan funds [28].

The transition to a "Green economy" is at the heart of the draft measures developed in accordance with the Decree of the President of the Republic of Uzbekistan dated September 11, 2023 No.PF-158 on the strategy "Uzbekistan – 2030", a number of goals were set to dramatically increase the use of renewable energy sources.

Including:

- increasing the capacity of renewable energy sources to 25,000 MW and their share in total consumption to 40%;
- development of the market for "green certificates" in the industry and the introduction of the practice of "environmental labeling";
- it is planned to stimulate the processes of formation of environmentally friendly infrastructure and the introduction of "circular economy" practices in industrial enterprises.

On the basis of a public-private partnership, solar power plants with a capacity of 9 GW, wind farms with a capacity of 5 GW, as well as 28 hydroelectric power plants with a capacity of 1.9 GW will be built. Natural gas consumption will be reduced by upgrading three thermal power plants with a capacity of 3 GW. A system of energy efficiency assessment (energy audit) of apartments in multi-storey buildings will be introduced.

According to the strategy, the transition of public transport to completely environmentally friendly fuels, the creation of a monitoring system covering all greenhouse gases in the field of climate change,

as well as the elimination of defects in the market economy in the context of "green growth". and the institutions of formation of "acceptable prices" are supposed to be strengthened [27].

References

1. А.А.Ахмедов, Э.А.Кудратов, Д.М.Холов. "Инновационные Технологии В Науке И Образовании" сборник статей победителей международной научно-практической конференции. 2016. Издательство: Наука и Просвещение. Пенза.
2. Б.Ф.Избосаров, А.А.Ахмедов, И.Р.Камалов. "Инновационные подходы к проведению лабораторных работ по физике". Новые технологии в образовании. 106-109.
3. E.N.Xudayberdiyev. "Bo'lajak fizika o'qituvchilarini tayyorlashda olamning fizik manzarasi bo'yicha tasavvurlarni shakllantirish". Academic research in educational sciences. 2021.
4. A.K.Kutbeddinov. "Generalization of uranium radio features in teaching natural sciencesak". Молодые ученые. 2023. 129-134.
5. I.R. Kamolov, G.I. Sayfullaeva -Formation of teacher's competence in the performance of laboratory and experimental works Journal of critical reviews. ISSN-2394-5125, 2020
6. D.I.Kamalova, S.N.Abdisalomova. "Zamonaviy innovatsion ta'lim". Journal of universal science research. Volume 1. Issue 1. 17 january, 2023. pp. 187-189.
7. Сарвиноз Тулкуновна Баракаева, Гулхаё Ихтиёровна Сайфуллаева, Сайибжан Садыкович Негматов, Нодира Сайибжановна Абед, Ихтиёр Рамазонович Камолов, Дилнавоз Ихтиёровна Камалова Методика получения композиционных образцов на основе термореактивных фурано-эпоксидных полимеров и органоминеральных наполнителей Universum: технические науки, 2021 1-1 (82) 42-45
8. L.K.Samandarov, E.N.Xudayberdiyev. Methodological problems of teaching the theory of particle-wave dualism for physics students. Theoretical&applied science. Теоретическая и прикладная наука. 256-262.
9. U.R.Bekpulatov. "Physical style of thinking-methodological basis for the formation of a scientific world view". Theoretical&Applied Science. 09(89). 183-188.
10. Ҳамроева Севара Насриддиновна, Камолов Ихтиёр Рамазонович. "Педагогика олий таълим муассасаларида бўлажак физика фани ўқитувчиларининг мантиқий фикрлаш қобилиятини stem таълим дастури асосида ривожлантириб ўқитишни такомиллаштириш". Science and innovation International scientific journal. volume 1. issue 6. UIF-2022. 2181-3337.
11. Каримова Ойниса Абдимуминовна. Активизация креативного мышления учащихся на уроке физики Традиции и новации в профессиональной подготовке и деятельности педагога. 227-229.
12. Azzamova Nilufar Buronovna, Nasriddinov Komiljon Rahmatovich. Electrodynamics As A Basis For Consolidating Knowledge Of Electromagnetism. Solid State Technology. 4(63). 5146.
13. У.Д.Шеркулов, А.М.Музафаров, Т.И.Солиев. Determination of mixing factors of daughter radionuclides in the uranium decay chain. Neuroquantology. September. 2022. Volume 20. Issue 11. London.
14. Sh.E.Khalilov, J.M.Khakkulov Z.Sh.Temirov. "Electrochemical Reduction Of Macroiones As A Surface-Active Nanocoating And Nanocomposites". The American Journal of Applied sciences. 2021.
15. Ж.М.Абдуллаев, Л.И.Очилов. "Изъятие пресной воды из подземных вод при помощи гелиоустановки водоносного опреснителя". Молодой учёный научный журнал. 2015/5. 274-276.

16. F.Nabiyeva. Issiqlik hodisalarini o‘qitishga oid umumiy metodik tavsiyalar. «Science and innovation». 446-449.
17. Tursunboy Izzatillo ugli Soliyev, Amrullo Mustafoyevich Muzafarov, Bahriddin Faxriddinovich Izbosarov. Experimental determination of the radioactive equilibrium coefficient between radionuclides of the uranium decay chain. International Scientific Journal Theoretical&Applied Science. 801-804.
18. L.X.Turabova, D.I.Kamalova. Fizika fanini o’qitishda elektron o’quv qo’llanmalardan foydalanishning ahamiyati. “Polish science journal”. Warsaw, Poland. Issue 4(37). April. 2021. pp. 222-225.
19. С.С.Канатбаев, И.Р.Камалов, Д.И.Камолова, Г.И.Сайфуллаева. “Universum: технические науки”. Россия. Декабрь, 2016. №12(33). 38-40 стр.
20. Хушвақтов Бекмурод Нормуродович. “Innovative Fundamentals of Non-Traditional Teaching (on The Example of The Optics Department)” Journal of Ethics and Diversity in International Communication”. e-ISSN: 2792-4017. www.openaccessjournals.eu. Volume.1 Issue.3.
21. A.R. Sattorov G. I. Sayfullaeva, Methodology of Application of Innovative Educational Technologies from Astronomy to Laboratory Activities 2021/10/29 European Journal of Life Safety and Stability (2660-9630) 125-128
22. O’.K.Sunnatova, G.I.Sayfullayeva. Making a vacuum cleaner using the stem education system in students' laboratory classes. Web of Discoveries: Journal of Analysis and Inventions. 2023. 43-47.
23. Sayfullaeva Gulkhayo Ikhtiyor Kizi, Shodiev Khamza Ruziculovich, Xaitova Shakhnoza G’olibjon Kizi Conditions For The Formation Of Teaching Innovation Activities Journal of Pharmaceutical Negative Results, 2023 2420-2423
24. Э. А. Кудратов Э. А. Аллаберганова, Г. М., Кутбеддинов, А. К., Каримов, А. М., Интерактивные методы обучения студентов естественных специальностей на основании радиационных факторов экосистемы. Педагогика и современность ISSN: 2304-9065
25. B. I Xojiyev, N.A. Ulugberdiyeva, AA Xo’jayev, AA Amonov Studying the transition processes in physics lessons Galaxy International Interdisciplinary Research Journal 10 (5), 873-876, 2022
26. Bozorova Aziza : Sayfullayeva Gulhayo Ixtiyor qizi Astronomiyadan stem dasturidan foydalanib quyosh soati mavzusini o’qitish - Yosh tadqiqotchi jurnali, 2022 35-38
27. Bobir Makhammadov The usage of android operating system mobile application terms in the russian language Proceedings of International Conference on Scientific Research in Natural and Social Sciences 2023/2/4 246-251
28. Khushvaktov Bekmurod Normurodovich Using fresnel bipprisms to explain the theme of light interference, science and innovation international scientific journal volume 2 issue 10 october 2023 46-48b, uif-2022: 8.2 | issn: 2181-3337 | scientists.uz
29. Хушвақтов Бекмурод Нормуродович Innovative Fundamentals of Non-Traditional Teaching (on The Example of The Optics Department) Journal of Ethics and Diversity in International Communication e-ISSN: 2792-4017 | www.openaccessjournals.eu | Volume: 1 Issue: 3