ISSN 2181-

HYDROELECTRIC ENERGY

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Abstract:

Hydropower is one of the alternative and renewable energy sources that converts the mechanical energy of flowing water into electrical energy. This type of energy is generated through hydroelectric power plants, where the flow of rivers, reservoirs, or waterfalls drives water turbines, which in turn power generators to produce electricity. Hydropower plays a significant role in meeting human energy demands in a stable manner, minimizing environmental impact, and reducing greenhouse gas emissions.

Keywords:

Hydropower, hydroelectric power plants, renewable energy sources, flow energy of water, electricity generation, hydraulic structures, sustainable energy source, environmental safety, energy efficiency, alternative energy, river energy, water turbines, energy resource utilization, natural resources, environmental protection, water resources, energy supply, advantages and disadvantages of hydropower, green energy, climate change mitigation.

Introduction:

Hydropower is a sector of electricity generation based on the use of the potential energy of water. It is one of the primary forms of renewable energy. In terms of total production, the leading countries in hydropower are China, Canada, and Brazil, while in per capita output, Norway, Iceland, and Canada lead globally.

In the early 21st century, the most intensive hydroelectric development has taken place in China, where hydropower is considered a key source of potential energy. The country accounts for nearly half of the world's small hydroelectric plants and is home to the world's largest hydroelectric power station—the Three Gorges Dam on the

Yangtze River. China is also constructing several of the largest hydroelectric facilities globally, with a combined capacity of around 72,000 MW [1-4].

Three Gorges Dam, China

The most powerful hydroelectric power station in the world is the Three Gorges Dam in China, with a total installed capacity of 22,500 MW and an annual electricity output of approximately 100 billion kWh, comparable to the Itaipu Dam shared by Brazil and Paraguay. In the Democratic Republic of the Congo (formerly Zaire), the construction of the Grand Inga Dam on the Congo River is planned by an international consortium, with a projected capacity of nearly 39,000 MW. Additionally, Russia has proposed the Penzhinskaya Tidal Power Station near the Sea of Okhotsk, in the Magadan Region and Kamchatka Krai, with an anticipated capacity of 87,000 MW. The largest hydroelectric power plants (such as the Three Gorges, Itaipu, and others) are among the world's largest power stations and hydraulic engineering structures. In addition to large-scale plants, small hydropower stations (mini-hydro) also exist. These typically have an installed capacity of no more than 5 MW, as seen in countries like Austria, Germany, Poland, and Spain. In Latvia and Sweden, small hydropower plants usually have a capacity of up to 2 MW, while in some other countries—such as Greece, Ireland, and Portugal—the threshold extends up to 10 MW. According to the European Small Hydropower Association (ESHA), any hydropower station with a capacity up to 10 MW is considered small. Sweden, for instance, has about 1,350 small hydro plants, which supply around 10% of the country's electricity needs. China is home to nearly 83,000 small hydropower plants. As of 2021, in Russia, small hydropower refers to

plants with a capacity not exceeding 50 MW (previously limited to 30 MW). The country has around 100 small hydropower stations with a combined capacity of approximately 90 MW and an annual output of nearly 200 million kWh. Most of the newly constructed small hydropower plants are located in the North Caucasus region [5-10].

The core principles of hydropower include the following: Utilization of potential energy of water: Hydropower uses the potential energy stored in elevated water reservoirs to generate electricity. Process consistency: Unlike other renewable sources such as solar and wind, hydropower ensures a continuous and stable flow of energy, making it a highly reliable source of electricity. Environmentally friendly: Hydropower is considered a clean energy source with minimal environmental impact [11-13]. It does not emit harmful substances into the atmosphere and does not require toxic materials for power generation. Cost efficiency: Hydropower is among the most cost-effective methods of electricity generation. Most hydroelectric power plants (HPPs) have long service lifespans, and their initial construction costs are recovered in a relatively short period. Operational flexibility: Hydropower allows for high flexibility in energy production management. It can adjust electricity output based on fluctuations in demand. Hydropower refers to the process of using the energy of flowing water to generate electricity. It plays a crucial role in both the economy and the environment for several reasons: The primary function of hydropower is to convert the mechanical energy of moving water into electrical energy. Hydroelectric power plants (HPPs) generate large volumes of electricity by harnessing the flow of rivers or reservoirs. This energy is widely used across industries, transportation, households, and other sectors. Hydropower is classified as a renewable and environmentally clean energy source. Its main objective is to reduce dependence on conventional energy sources such as coal, gas, and oil; minimize emissions of harmful gases into the atmosphere; and promote environmental sustainability. Hydropower is also vital for ensuring a country's energy independence through the use of domestic and internal energy resources, thereby

reducing reliance on energy imports and strengthening national energy security [14-19].

Utilization of natural water resources for energy generation;

Production and distribution of electrical energy;

Integrated use of water resources (including land reclamation, irrigation, and water supply);

Ensuring energy security and reducing dependence on energy imports.

Conclusion:

Hydropower is one of the alternative and renewable energy sources based on converting the movement or pressure of water into electricity. It offers humanity an environmentally friendly, stable, and long-term method of energy production. The main advantage of hydropower lies in its ability to generate electricity using water resources without emitting greenhouse gases, making it a critical tool in the fight against global warming. Modern hydropower development is advancing in two main directions: large-scale hydropower plants and small-scale (mini) hydropower plants. Large hydroelectric stations are designed to generate substantial amounts of electricity, providing energy to entire countries or industrial sectors. Mini-hydropower stations, on the other hand, are essential for supplying electricity to local or remote areas in an environmentally safe manner. However, hydropower also has certain drawbacks. The construction of large dams requires significant financial investment and can sometimes negatively impact the environment, local climate, and the livelihoods of nearby communities. Nevertheless, modern technologies are increasingly aimed at minimizing these negative effects. For countries like Uzbekistan, which are rich in water resources, hydropower represents a strategic path toward economic stability, energy independence, and green development. Advancing this sector not only improves energy supply but also contributes to job creation, infrastructure development, and enhanced environmental security.

REFERENCES

1. Yusupov Abdurashid Khamidillaevich. (2025). THE PHYSICAL ESSENCE OF THE VOLT-AMPERE CHARACTERISTICS OF SOLAR CELLS. *World Scientific Research Journal*, *38*(1), 387–391. Retrieved from https://inlibrary.uz/index.php/wsrj/article/view/93407

2. Yusupov Abdurashid Khamidillaevich, & Oripova Dilnoza Karimjon kizi. (2025). TYPES OF PHOTOVOLTAIC CELLS AND THEIR EFFICIENCY. *World Scientific Research Journal*, *38*(1), 392–397. Retrieved from https://inlibrary.uz/index.php/wsrj/article/view/93406

3. Yusupov Abdurashid Khamidillaevich, & Yuldasheva Saodatkhon Sultonbek kizi. (2024). APPLICATION OF PHOTOVOLTAIC EFFECTS TO ENERGY SAVING MATERIALS. *Лучшие интеллектуальные исследования*, *21*(2), 62–68. Retrieved from https://web-journal.ru/journal/article/view/5316

4. Yusupov Abdurashid Khamidullayevich, & Khakimov Ulugbek ogli. (2024). DEVICES COLLECTING SUNLIGHTS. *Лучшие интеллектуальные исследования*, *21*(1), 193–199. Retrieved from https://web-journal.ru/journal/article/view/5297

5. Yusupov Abdurashid Khamidillaevich, & Artikov Dilshodbek Xushbakjon ogli. (2024). APPEARANCE OF PHOTOVOLTAIC EFFECT IN POLYCRYSTAL SILICON BASED RECEIVER. *Лучшие интеллектуальные исследования*, *21*(1), 179–186. Retrieved from https://web-journal.ru/journal/article/view/5295

6. Yusupov Abdurashid Khamidullayevich, & Rozmamatov Oybek Dilshodbek ogli. (2024). OBTAINING ELECTRICAL ENERGY USING DEVICES COLLECTING SUNLIGHTS. *Лучшие интеллектуальные исследования*, *21*(1), 187–192. Retrieved from https://web-journal.ru/journal/article/view/5296

7. Yusupov Abdurashid Khamidullayevich, & Artikov Dilshodbek Khushbaqjon ogli. (2024). PHOTOVOLTAIC EFFECTS AND THEIR EFFECTIVE USE. *Лучшие интеллектуальные исследования*, *14*(2), 21–27. Retrieved from https://web-journal.ru/journal/article/view/2884

8. Yusupov Abdurashid Xamidullayevich, & Qodiraliyev Nursaid Botirali o`g`li. (2024). QUYOSH SPEKTRI VA FOTOELEKTRIK MATERIALINING YUTILISH SPEKTRI O‘RTASIDAGI NOMUVOFIQLIKNING TA’SIRINI KAMAYTIRISH. *Лучшие интеллектуальные исследования*, *14*(2), 64–71. Retrieved from https://web-journal.ru/journal/article/view/2891

9. Yusupov Abdurashid Xamidullayevich, & Yuldasheva Saodatkhan Sultanbek kizi. (2024). PPLICATION OF PHOTOVOLTAIC EFFECTS TO ENERGY-SAVING MATERIALS COMPONENTS OF THE STRUCTURE AND SOLAR CELLS. Лучшие интеллектуальные исследования, 14(2), 105–109. Retrieved from http://web-journal.ru/index.php/journal/article/view/2897

10. Kodirov, D., Makhmudov, V., Normuminov, J., Shukuraliev, A., Begmatova, N., & Abdurashid, Y. (2024). Determination of the optimal angle for high efficiency of solar panels in Uzbekistan. In E3S Web of Conferences (Vol. 563, p. 01008). EDP Sciences.

11. Khamidillaevich, Y. A., & Abdumalik, T. (2024). HIGH TEMPERATURE SOLAR CONCENTRATORS. Лучшие интеллектуальные исследования, 21(1), 200-206.

12. Юсупов Абдурашид Хамидиллаевич, & Хамдамова Наргизой Хамидуллаевна. (2024). ЭЛЕКТРОМАГНИТ ИНДУКЦИЯ МАВЗУСИНИ ИНТЕРФАОЛ МЕТОДЛАР БИЛАН ЎҚИТИШ. PEDAGOGS, 48(1), 43–50. Retrieved from https://pedagogs.uz/index.php/ped/article/view/575

13. THE EFFICIENCY OF SOLAR PANELS DEPENDS ON CLIMATIC CONDITIONS. (2025). *Лучшие интеллектуальные исследования*, *46*(5), 41-46. https://scientific-jl.com/luch/article/view/20066

14. OBTAINING ELECTRICITY FROM SOLAR PANELS AND INCREASING THEIR EFFICIENCY. (2025). *Лучшие интеллектуальные исследования*, *46*(5), 36-40. https://scientific-jl.com/luch/article/view/20065

15. QUYOSH KONSENTRATORLARI. (2025). *Лучшие интеллектуальные исследования*, *46*(3), 211-218. https://scientific-jl.com/luch/article/view/19713

16. BASIC PARAMETERS OF THERMOELECTRIC MATERIALS. (2025). *Лучшие интеллектуальные исследования*, *46*(3), 81-92. https://scientific-jl.com/luch/article/view/19431

17. MOLECULAR BEAM EPITAXY. (2025). *Лучшие интеллектуальные исследования*, *46*(3), 70-80. https://scientific-jl.com/luch/article/view/19430

18. FIELDS OF APPLICATION OF PHOTOVOLTAIC CELLS BASED ON ORGANIC MATERIALS. (2025). *Лучшие интеллектуальные исследования*, *36*(1), 81-87. https://scientific-jl.org/luch/article/view/8351

19. Oripova Dilnoza Karimjon kizi, & Yusupov Abdurashid Khamidillaevich. (2024). PHENOMENON OF PHOTO EFFECT IN SEMICONDUCTORS. *JOURNAL OF NEW CENTURY INNOVATIONS*, *67*(4), 132-137. https://scientific-jl.org/new/article/view/7623