SOLAR PV SYSTEMS IN DEVELOPING ECONOMIES CHALLENGES AND OPPORTUNITIES



Jo‘ramurotova Shahlo Muhiddin qizi
Jizakh Polytechnical institute
Department of Energy, master student
willofqueen@gmail.com

Annotation

This topic explores the adoption of solar PV systems in developing economies, focusing on the challenges of high costs, inadequate infrastructure, and policy barriers. It also highlights the opportunities presented by technological advancements, international funding, and favorable climatic conditions for solar energy. The study emphasizes the role of solar PV in addressing energy poverty and promoting sustainable development in these regions.

Keywords: Solar photovoltaic (PV) systems, renewable energy, energy poverty infra structure challenges, , solar energy adoption, greenhouse gas emissions reduction, climate conditions, economic growth, energy transition.

The topic of **"Solar PV Systems in Developing Economies Challenges and Opportunities"** is highly relevant in the context of Uzbekistan, a country in Central Asia with vast potential for solar energy development. Like many developing economies, Uzbekistan faces the dual challenge of meeting growing energy demands while transitioning to more sustainable and cleaner energy sources. The adoption of solar photovoltaic (PV) systems presents a promising solution, given Uzbekistan’s abundant sunlight, with over 300 sunny days per year, making solar energy a viable and essential resource.

Uzbekistan has historically been heavily reliant on fossil fuels, particularly natural gas, to power its economy. However, with rising environmental concerns, aging energy infrastructure, and a commitment to reducing carbon emissions, the government is actively seeking to diversify its energy mix. Solar PV offers an opportunity for Uzbekistan to reduce its dependence on non-renewable energy sources, enhance energy security, and meet the needs of its rapidly growing population and industries.

Uzbekistan's geographic location and favorable climate make it an ideal region for solar energy production. The Uzbek government has introduced ambitious renewable energy targets, including plans to install 7 GW of solar power by 2030. IN international Partnerships Uzbekistan is attracting foreign investments and international partnerships, including support from organizations like the Asian Development Bank and the World Bank, to develop large-scale solar PV projects.

Securing the necessary funding for large-scale solar projects remains a challenge, especially in terms of attracting private-sector investment. Uzbekistan's aging grid infrastructure needs modernization to fully integrate intermittent solar energy. While progress has been made, further regulatory reforms are necessary to streamline project development and incentivize private sector participation.

Overall, solar PV systems in Uzbekistan present a significant opportunity for addressing the country’s energy challenges. By overcoming financial, infrastructural, and regulatory barriers, Uzbekistan can leverage solar energy to drive sustainable growth and development. The current state of solar photovoltaic (PV) adoption in Uzbekistan is advancing rapidly, as the country looks to diversify its energy portfolio and reduce its dependency on natural gas. As a developing economy, Uzbekistan faces both opportunities and challenges in scaling up solar energy. The government has set ambitious goals and partnered with international organizations to promote renewable energy, making solar PV a cornerstone of the country's energy transition.

The Uzbek government is committed to increasing the share of renewable energy in its energy mix. The country aims to install 7 GW of solar capacity by 2030 as part of its national strategy to reduce carbon emissions and achieve greater energy independence. The introduction of the Renewable Energy Law (2019) has been a key driver in promoting solar investments by offering tax incentives, favorable tariffs, and easing the permitting process for solar projects.

The government's strategy includes generating 25% of its electricity from renewable sources by 2030, with solar PV playing a leading role in achieving this target. Uzbekistan has seen a number of large solar PV projects being developed

Commissioned in 2021, this 100 MW plant is one of the first utility-scale solar projects in the country, supported by the Asian Development Bank (ADB).

A 457 MW project in Surkhandarya, awarded to UAE-based Masdar, is under development. It is one of the largest solar projects in the region and is expected to be operational by 2024.

Another major solar project, with a capacity of 220 MW, is being developed to contribute significantly to the country's renewable energy targets.

Uzbekistan is actively seeking international partnerships to finance and build solar infrastructure. International institutions like the World Bank, the European Bank for Reconstruction and Development (EBRD), and the Asian Infrastructure Investment Bank (AIIB) are providing funding and technical assistance. Competitive solar tenders have attracted foreign investments from companies based in the UAE, Saudi Arabia, and China, contributing to the growth of solar PV capacity.

Uzbekistan enjoys over **300 sunny days per year**, giving it strong potential for solar energy production. The country's vast desert and semi-arid regions provide ample space for large-scale solar installations. Uzbekistan's electricity grid is in need of modernization to handle the intermittent nature of solar energy. Upgrading grid infrastructure and integrating energy storage systems are crucial to maximizing the efficiency of solar PV systems.

The adoption of solar photovoltaic (PV) systems in developing economies presents numerous opportunities, but it also faces several challenges. These challenges range from financial constraints and regulatory issues to technical and infrastructure-related difficulties. Addressing these barriers is crucial for accelerating the deployment of solar PV and achieving long-term energy sustainability in developing nations.

Despite the falling costs of solar PV technology, the initial investment required for large-scale solar projects remains a significant barrier. Many developing countries struggle to secure the necessary capital due to limited access to financing and weak financial markets. Attracting private sector investment can be challenging due to perceived risks such as currency instability, political uncertainty, and unclear regulatory environments. Many solar PV projects in developing countries rely heavily on international aid or loans from organizations like the World Bank, which may not be sustainable in the long term.

Many developing economies have outdated or poorly maintained electricity grids, which are not equipped to handle the intermittent nature of solar power. Upgrading grid infrastructure to accommodate solar PV can be costly and time-consuming. In many developing countries, especially in remote or rural areas, grid access is limited. Off-grid solar systems can be a solution, but connecting these systems to a larger energy network often presents technical and logistical challenges.

Solar energy generation is intermittent, and energy storage technologies, such as batteries, are crucial for ensuring a stable supply of electricity. However, energy storage solutions remain expensive and are not yet widely deployed in many developing countries, limiting the reliability of solar PV systems. In some areas, hybrid systems combining solar with diesel or other forms of backup energy are used to overcome this challenge, but these are often expensive and not a fully sustainable solution.

Many developing countries lack stable or coherent policy frameworks to support solar PV adoption. Regulatory uncertainty can deter investors and slow the development of solar projects. Governments in developing economies may not offer sufficient incentives, such as feed-in tariffs, tax breaks, or subsidies, to encourage widespread investment in solar PV. Without these incentives, the financial viability of projects can be uncertain. Bureaucratic hurdles and slow approval processes can delay solar project development and increase costs.

Developing countries often lack skilled labor and technical expertise in designing, installing, and maintaining solar PV systems. This reliance on foreign expertise can increase project costs and hinder the development of a local solar industry. Capacity building through training programs and the establishment of local manufacturing and installation industries is essential to overcome this challenge and ensure the long-term sustainability of solar PV adoption.

Many developing economies rely on importing solar PV components, which can lead to supply chain disruptions, higher costs, and delays. Dependence on external suppliers also leaves countries vulnerable to fluctuations in global prices for solar equipment. Remote or rural areas may face logistical challenges in transporting solar PV materials, which can increase project costs and delay installation timelines. To overcome these challenges, developing economies need to implement comprehensive strategies that involve

Governments should develop stable, long-term policy frameworks that provide clear incentives for solar investment, streamline permitting processes, and create favorable conditions for private sector involvement.

Collaboration with international financial institutions and development agencies can provide the funding and technical assistance necessary to develop solar projects. Developing local expertise in solar PV installation, operation, and maintenance through training programs and educational initiatives is crucial for building a self-sustaining solar industry. Investing in grid modernization and energy storage technologies will help address the intermittent nature of solar power and ensure reliable electricity supply. Despite these challenges, solar PV remains a key opportunity for developing economies to address their energy needs, reduce carbon emissions, and foster sustainable economic growth. With the right policy frameworks and investments, solar PV can significantly improve energy access and contribute to a greener energy future.

Many developing economies are heavily reliant on fossil fuels for electricity generation, contributing to air pollution and greenhouse gas emissions. Solar PV provides a clean energy alternative, enabling these countries to reduce their carbon footprints and meet global climate targets, such as those set out in the Paris Agreement. Solar PV aligns with global sustainability goals, including the United Nations' Sustainable Development Goal 7 (SDG 7), which aims to ensure access to affordable, reliable, and modern energy for all by 2030.

Many developing countries rely on costly imports of fossil fuels, which exposes them to price volatility and supply risks. Solar PV can reduce dependence on imported energy sources, improving national energy security and stabilizing energy costs. Solar PV helps diversify the energy mix by adding renewable energy capacity alongside other forms of generation. This reduces the vulnerability of economies to supply disruptions or fuel price shocks. The solar PV sector creates jobs across various stages of the supply chain, from manufacturing and installation to maintenance and operation. Developing economies can benefit from job creation in local communities, providing employment opportunities and supporting skills development. Solar PV projects, especially large-scale ones, attract foreign investment, create demand for local products and services, and contribute to overall economic growth. In addition, the reduction in energy costs provided by solar can boost productivity and competitiveness in industries reliant on affordable electricity.

Numerous international organizations and development banks, such as the World Bank, the Asian Development Bank (ADB), and the International Renewable Energy Agency (IRENA), are actively supporting the adoption of solar PV in developing economies. These institutions provide financing, technical assistance, and policy guidance to help countries overcome barriers to solar development. Developing economies can access climate finance from sources such as the Green Climate Fund (GCF) to support their renewable energy projects. These funds help bridge the financial gap for countries that need capital to invest in solar infrastructure.

In conclusion, the implementation of solar PV systems in developing economies presents both significant challenges and promising opportunities. While high upfront costs, inadequate infrastructure, and policy constraints pose obstacles to widespread adoption, the potential benefits are immense. Solar PV systems offer a clean, renewable energy source that can address energy

access issues, reduce greenhouse gas emissions, and contribute to sustainable economic growth. With supportive policies, international funding, technological innovation, and investment in local capacity building, solar PV can play a transformative role in fostering energy independence and promoting long-term socio-economic development in these regions.

Reference

1.Zafar, M. W., Saud, S., Hou, F., & Sinha, A. (2021). The role of renewable and nonrenewable energy and energy efficiency on environmental quality: A global perspective. *Environmental Science and Pollution Research*

2.This paper discusses the global perspective of renewable energy adoption, including the role of solar PV systems in enhancing environmental sustainability, especially in developing regions. It provides insights into both the challenges and opportunities faced by developing economies in transitioning to clean energy solutions.

3. Sarvar o'g'li, M. S. (2024). DAVLAT BOSHQARUV TIZIMINING VA UNING MOXIYATI. Ta'limning zamonaviy transformatsiyasi, 8(4), 192-196.

4. Rakhmonkulov, F. P. (2022). THE IMPORTANCE OF SOFTWARE IN WEBSITE DESIGN. In СОВРЕМЕННАЯ НАУКА, ОБЩЕСТВО И ОБРАЗОВАНИЕ: АКТУАЛЬНЫЕ ВОПРОСЫ, ДОСТИЖЕНИЯ И ИННОВАЦИИ (pp. 129-131).

5. Rakhmonkulov, F. P. (2022). Development of web design competence of future IT teachers. In SUSTAINABLE DEVELOPMENT FORUM-2022 (pp. 111-114).