

**ENERGY-EFFICIENT TECHNOLOGIES AND THEIR ROLE IN THE
"GREEN" ECONOMY**

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Abstract. The article analyzes the impact of using energy-efficient technologies on economic development and their positive effects on the environment. It discusses the concept of energy-efficient technologies, their main types, and their role in the formation of a "green" economy. In addition, it presents information on the measures implemented and those planned in the Republic of Uzbekistan in this field.

Keywords: energy-efficient technologies, green economy, renewable energy sources, energy efficiency, sustainable development, environmental safety, innovative technologies.

Introduction. In the 21st century, issues such as sustainable economic development, rational use of natural resources, and ensuring energy security are becoming increasingly important for the world community. Today, as a result of the rapid development of the global economy, the increase in the standard of living of the population, and the emergence of new production sectors, the demand for products and services is increasing day by day. At the same time, the need for energy resources is also increasing sharply. Especially since the second half of the 20th century, the consumption of electricity has grown very rapidly and has become an integral part of human life.

However, such a rapid growth in energy consumption creates a number of problems. First of all, the depletion of fuel and energy resources, their rising prices and increased dependence on imports affect economic stability. At the same time, the increase in the amount of greenhouse gases emitted into the atmosphere during the use of traditional energy sources is causing climate change, drought and disruption of the ecological balance. As a result, the current world economic model has shown itself to be unsustainable and there is a need to choose a new path of development.

In such conditions, the transition of the economy to a "green" direction has become one of the most important strategic tasks on a global scale. At the heart of the "green" economy are energy-saving technologies. They serve to reduce energy consumption, rationally use resources, and minimize environmental damage while maintaining production volumes. As a result of the widespread introduction of such technologies, enterprises reduce production costs, the cost of products becomes cheaper, and efficiency in the economy increases.

This issue is also very relevant in the conditions of Uzbekistan. Since the country's economy is mainly based on fossil fuels, increasing energy efficiency and expanding the use of renewable energy sources has become one of the priority areas of state policy. Today, large-scale projects are being implemented to use solar and wind energy, energy-saving technologies are being introduced in production sectors. Also, the use of thermal insulation and energy-saving lighting systems in residential buildings is becoming more popular.

It should be noted that since the climatic conditions of Uzbekistan are sharply continental, energy efficiency is of great importance not only for economic benefit, but also for ensuring environmental safety. Therefore, the introduction of energy-saving technologies is considered the basis for the transition to a "green" economy in our country. This is the most correct way to ensure sustainable economic growth in the future, rational use of natural resources and preservation of ecological balance.

LITERATURE ANALYSIS

The "green" economy and the prospects for its transition have been studied in the scientific works and research of economists AV Vakhobov and Sh.Kh. Khajibakiyev[1].

In our country, BA Mirzayev examined the prospects for Uzbekistan's transition to a "green" economy in his research. He analyzed the current economy of the republic, identified the core of the problems it is facing, and made specific proposals for eliminating these problems by transitioning to a "green" economy.[2]

In his scientific study, O.G. Gafurov described the approaches of specialists who have conducted scientific research in this area and the need to further expand the use of energy-saving methods in the world[3]

has proposed solutions in his research that promote the principles of reducing energy consumption, efficient use of resources, and a "green" economy. In his scientific work, the researcher also highlighted the practical experiences of advanced countries, as well as ways to achieve sustainable development through increasing energy efficiency [4].

RESEARCH METHODOLOGY

Review of literature on the topic, Systematic analysis method - to study energy-saving technologies as a component of the "green" economic system, Comparative analysis method - to compare the experience of developed countries (Germany, Japan, Denmark) and Uzbekistan, Abstraction and generalization - to analyze theoretical concepts and approaches, Synthesis method - to summarize information from various sources into a single system.

The theoretical significance of the research lies in the scientific substantiation of the connection between energy-saving technologies and the "green" economy, and the practical significance lies in the development of proposals that can be applied for Uzbekistan.

ANALYSIS AND RESULTS

To understand the place of energy-efficient technologies in a "green" economy, we first need to understand what these technologies are, their types, and their advantages.

Energy-efficient technologies are systems designed to perform the same functions as existing technologies, but with significantly less energy consumption. Such technologies reduce energy consumption by an average of up to 15 percent without compromising the quality or efficiency of production capacity. The result is lower energy costs, reduced pollution levels, and environmental sustainability.

Essentially, such technologies aim to improve energy efficiency, reducing energy losses through methods such as waste, heat recovery, storage or use, and reducing final energy demand. They are widely used in residential, commercial, industrial and transport sectors, and play an important role in minimizing energy waste, using energy wisely and integrating renewable sources into systems.¹

Energy-efficient technologies are used in many industries. Examples of these technologies include:

1. LED lighting technology

Light-emitting diode (LED) lamps are one of the most energy-efficient lighting technologies. They use up to 90 percent less energy to produce the same amount of light than traditional incandescent lamps and last 25 times longer.

2. Smart thermostats

Smart thermostats increase the efficiency of heating and cooling systems, learn user habits and preferences, and automatically maintain a comfortable temperature. They also allow remote control via smartphone apps, allowing users to control the temperature in their home from anywhere.

3. Electric vehicles and regenerative braking system

Electric and hybrid cars can convert about 77 percent of their electrical energy into wheel motion, which is much more efficient than gasoline cars, which can only convert 12–30 percent of the energy from the fuel into motion.

These cars are equipped with a regenerative braking system that recovers energy lost as heat during braking and transfers it to the vehicle's battery. This significantly increases energy efficiency, especially in urban environments with frequent stop-and-go driving.

4. High- efficiency solar panels

High-efficiency solar panels convert a greater proportion of sunlight into electricity, resulting in more power generated per unit area than previous generation technologies. Such

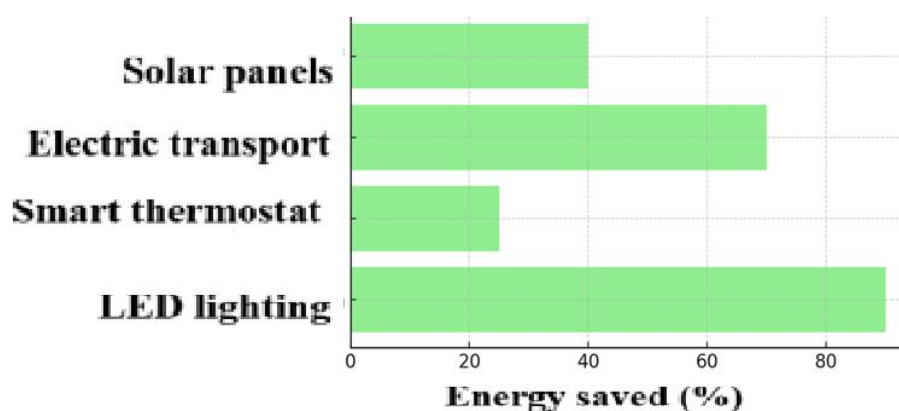
¹ <https://www.azocleantech.com/article.aspx?ArticleID=1863>

panels typically remain effective for 25–30 years, after which their energy production gradually begins to decline.

It is estimated that using high-efficiency solar panels can save homeowners an average of \$1,500 per year in electricity costs. Over the life of the entire system, this amount can provide savings of \$25,500 to \$33,000.

This significant reduction in energy costs and the reduction in the need for fossil fuels makes high-efficiency solar panels one of the most promising energy-saving technologies.²

Figure 1. Efficiency of energy-saving technologies. Energy saved in percent (%).



As can be seen in this (Figure 1), each of the technologies individually affects energy efficiency. LED lighting systems are the most effective energy-saving, low-cost technology.

There are many other types of energy-saving technologies. Scientists are developing new types and implementing them in the fields.

Energy-efficient technologies are crucial in the fight against climate change, as they reduce energy consumption and related greenhouse gas emissions. As the Intergovernmental Panel on Climate Change (IPCC) has noted, these technologies are essential to the international effort to limit global warming to 1.5 °C above pre-industrial levels.

Energy-efficient technologies also increase energy security because they reduce dependence on fossil fuels, which is increasingly important in today's era of increasing global energy demand.

The transition to a "green" economy has become a major issue for all developed countries today. This is due to the deterioration of the environment and the demand for energy resources. The United States and the European Union consider the solution to this problem to be the

² <https://www.azocleantech.com/article.aspx?ArticleID=1863>

transition to new economic models. Developed countries are trying to reduce energy consumption while maintaining current potential, using energy-efficient technologies in their industrial and other sectors.

In the Republic of Uzbekistan, along with developed countries, a number of works are being carried out to transition to a "green" economy and use new, modern energy-saving technologies in the economy. The fact that our President Sh.M. Mirziyoyev named 2025 the "Year of Environmental Protection and the "Green" Economy" also indicates that the above issue has risen to the level of state policy.

Small businesses in Uzbekistan will have the opportunity to invest in energy efficiency and renewable energy projects through a pilot Green Economy Financing Facility signed between the European Bank for Reconstruction and Development and the Silk Road Bank.

This program provides loans to small and medium-sized enterprises, as well as large companies, to invest in green technologies that reduce greenhouse gas emissions and help adapt to and mitigate the effects of climate change.

Ipak Yuli Bank, the first local partner in the program, has received a €4.4 million credit line from the European Bank for Reconstruction and Development. This funding will enable private enterprises to invest in the following areas:

thermal insulation systems;

solar photovoltaic panels;

geothermal heat pumps ;

water saver irrigation systems.

Enterprises "Green Economy" for funding program" technology selector through to themselves suitable green technologies selectively they receive possible.

For now European Bank for Reconstruction and Development Uzbekistan 70 projects for the economy from 1.3 billion euros within more than investment entered.³

The World Bank Group, Abu Dhabi's future energy company Masdar, and the Government of Uzbekistan have signed a financing agreement for a 250 megawatt (MW) solar photovoltaic power plant and a 63 MW battery energy storage system (BESS). The project aims to provide clean and sustainable electricity to approximately 75,000 households.

The financing package includes loans of up to \$53 million from the International Finance Corporation (IFC) and up to \$106 million from the Asian Development Bank (ADB), the Netherlands Enterprise Development Bank (FMO) and the Japan International Cooperation

³ https://ebrdgeff.com/uzbekistan-geff1/geff-in-uzbekistan/?utm_source=chatgpt.com

Agency (JICA). These funds will be used to build and operate the plant. IFC will also provide interest rate swaps on the entire loan amount to manage interest rate risk.

This solar power plant, to be built in the Olot district of the Bukhara region, will generate more than 585 gigawatt-hours of renewable energy per year and reduce carbon dioxide (CO₂) emissions by more than 327,000 tons per year.

The Uzbek government, taking into account the growing energy needs of the economy and the population, plans to increase renewable energy production to 25 gigawatts by 2030, i.e. to provide 40 percent of the country's electricity consumption from these sources. The World Bank Group is assisting Uzbekistan in this regard by attracting private investment in the development of 2,000 MW of solar and 500 MW of wind power.

The project is being implemented through Masdar-owned Nur Bukhara Solar PV LLC. The company is responsible for the development, financing, construction, ownership, operation and maintenance of the solar power plant and energy storage system. It will sell electricity to the state-owned National Electric Grids of Uzbekistan JSC under a 25-year power purchase agreement, with a 10-year operating period for the BESS system.⁴

A new project aimed at reducing greenhouse gas emissions and improving energy efficiency in schools, hospitals and public transport in Uzbekistan was launched in Tashkent on June 18, 2025. The initiative is being implemented by the United Nations Development Programme (UNDP), with the support of the Government of Japan and the Ministry of Economy and Finance of Uzbekistan. The project will help reduce energy crises in the country caused by extreme heat and cold, and make infrastructure more resilient to sudden climate changes.

- Energy-efficient buildings. Schools, hospitals, and kindergartens will be equipped with thermal insulation, energy-efficient windows, heat pumps, and solar panels. This will reduce energy consumption and create comfortable conditions all year round.
- CO₂ emissions and air pollution reduce Clean from technologies use and mining to fuels addiction reduce through carbon trace reduces , urban and rural in the regions the air cleans.
- heat and cold convenience. Modern heating and cooling systems external from the temperature strict look , inside the building stable the climate keeps.
- "Green" transport support. Project within electric transport, power supply infrastructure and directions according to air monitoring systems test as a rule current is being done.
- Japan investments and technologies. Japan's joint credit through the mechanism (JCM) financing , technology and experience attraction is done , this and successful solutions whole country along expansion opportunity creates.⁵

⁴ https://www.ifc.org/en/pressroom/2024/uzbekistan-to-build-new-solar-plant-and-first-battery-energy-storage-system-with-world-bank-group-support?utm_source=chatgpt.com

⁵ https://www.undp.org/uzbekistan/press-releases/undp-and-japan-launch-decarbonization-project-uzbekistan?utm_source=chatgpt.com

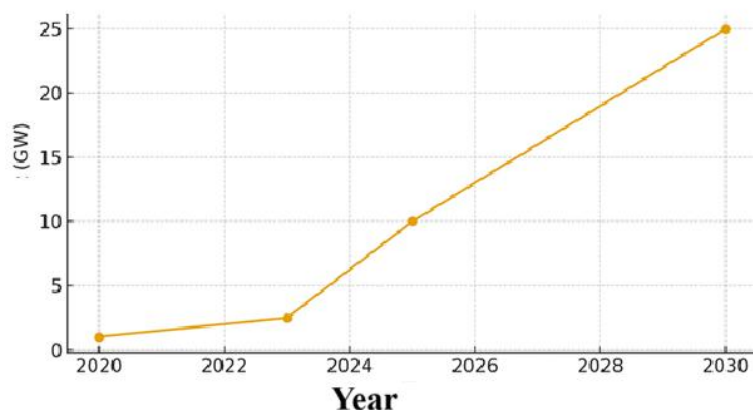


Figure 2. In Uzbekistan again recovering energy sources growth forecast. Gigawatt (GW)

In picture 2, in Uzbekistan again recovering energy capacity between 2020–2030 step by step growth reflection. From the diagram visible it is clear that in 2020 the country again recovering energy sources power only 1 gigawatt organization reached if, by 2023 this indicator 2.5 gigawatts reached. To be implemented in 2025 increasing large sun and wind electricity stations projects complete to work fall as a result power to 10 gigawatts output expected by 2030 and this indicator 25 gigawatts delivery planned is, this country electricity energy consumption about 40 percent again recovering sources through cover opportunity. This gives tendency in Uzbekistan energy system fundamentally modernization "green" is being done to "economy" transition policy in practice result giving and energy independence provision and greenhouse gases waste reduce on the way important steps being put shows.

Analyses to the result according to, in Uzbekistan energy economical of technologies step by step current to be economic growth quality in terms of new to the model transition for ground. This process is long. within the period energy to resources addiction reduce, stabilize economic development provides.

CONCLUSION AND SUGGESTIONS

The transition to a "green economy" in our country requires new technological approaches in the energy, industrial and social spheres. Energy-efficient technologies are at the heart of this process, which, while increasing economic efficiency, serve to maintain ecological balance. The results of the study show that the introduction of these technologies not only reduces the need for energy resources, but also reduces production costs and strengthens the competitiveness of the national economy.

Uzbekistan's experience shows that supporting a "green" approach at the state policy level, implementing large-scale projects in cooperation with international financial institutions, is bringing energy efficiency policy to a practical stage. At the same time, issues such as

developing the technological production base, expanding scientific research, and diversifying financial instruments are still relevant.

In general, the introduction of energy-efficient technologies establishes the principles of sustainability and innovative growth in Uzbekistan's long-term development strategy. This process contributes to the formation of a new development model that combines economic benefits, environmental safety, and social well-being.

Based on this, it is appropriate to put forward the following proposals:

1. Local technology working release base development

Energy efficient equipment , smart systems and recycling recovering energy devices local under the circumstances working to release on the road to put necessary. This is a from the side to import addiction reduces , second from the side and new work their places creates and technological independence provides. For this purpose public-private partnership mechanisms expansion , research institutions and industries issuer enterprises between innovative clusters organization to grow to the goal appropriate will be.

2. Financial mechanisms improvement.

"Green bonds ", international "green finance" instruments and special grants and subsidies through energy thrift projects financing system reinforcement In this case , private sector attraction to grow important because energy efficiency in the field innovative solutions most of entrepreneurship to their initiatives also relies on low interest rates loans and preferential to tax pull mechanisms through of enterprises energy saver to technologies the passage encouragement necessary.

3. Normative, legal and institutional the base reinforcement.

Energy efficiency and “ green ” to "economy" related there is law documents international to standards adaptation , their performance control doer independent agency or wide establishment of an authorized body to grow In this case, the state policy only normative order to plant with unlimited energy to save economic incentives through support important.

4. Personnel training and scientific potential increase

Energy efficiency , environmental management , re recovering energy technologies in the fields qualified experts to prepare systematic basically on the road to put necessary. High training " green " in their countries economy and energy to the management related special sciences current international scientific cooperation strengthen , age scientists grant programs for on the road to put positive results gives.

5. Forming a culture of energy saving among the population and business entities.

Improving energy efficiency is not just a technical measure, but a process of changing social awareness and behavior. Therefore, it is important to increase the environmental

responsibility of the population through large-scale information campaigns, educational projects and advocacy, and to establish an energy audit system in households and enterprises.

6. Introduction of digital technologies.

Smart grids and digital management systems that enable real-time monitoring of energy consumption and data-driven efficiency improvements should be gradually implemented. This will allow energy savings to be assessed and managed based on accurate figures.

This offers done increase Uzbekistan economy from resources effective to use based , ecological in terms of sustainable and innovative development on the way take The result is country energetic independence supply , international competitiveness increase and citizens life quality improve regarding noticeable to achievements achieves.

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