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GREEN TECHNOLOGIES AND THEIR IMPACT ON ECONOMIC EFFICIENCY

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Abstract: The article analyzes the role of green technologies in the modern economy, their impact on economic efficiency and the results of their application in various industries. Through the introduction of green technologies in energy, transport, construction and agriculture, the possibilities of reducing costs, efficient use of resources and achieving economic growth are outlined. The prospects and measures for the development of green technologies in the conditions of Uzbekistan are also substantiated.
Key words: green technologies, sustainable development, renewable energy, energy efficiency, environmental transport, green building technologies, waste recycling, climate change, innovation economy, green economy of Uzbekistan

Nowadays, against the background of the acceleration of globalization and industrialization processes, the need to ensure environmental stability in the face of the world economy has sharply increased. Factors such as the increasing pressure of traditional production methods on resources, pollution of the atmosphere, water and soil layers, and the escalation of global climate change are calling for the implementation of the concept of sustainable development into practice. In these conditions, green technologies are seen as the main tool that allows you to achieve an optimal balance between economic development and environmental safety. Green technologies is a complex of innovative solutions aimed at protecting the environment, optimizing energy and raw material consumption, recycling waste and reducing carbon emissions.The term green technology has become widely popular globally since the late 20th century, but by the 21st century this direction has become a strategic necessity for Human Development. In particular, most of the 17 goals to be achieved by 2030 under the United Nations ' Sustainable Development Goals (SDGs) call for the widespread introduction of green technology. After all, without reducing the ecological traces of economic growth, real sustainable development and social well-being cannot be achieved. The importance of green technologies is that through them not only resources are saved, but new innovative industries are created, qualitatively new professions are formed in the labor market, and the strength of socio-economic systems increases.In addition, the growing share of renewable energy sources in the global energy market in recent decades, with increasing trends in the transition to ecological vehicles in urban infrastructure, the widespread introduction of water-saving and soil-preserving technologies in agriculture demonstrates the real economic efficiency of green technologies. In particular, international financial institutions and leading industrial enterprises are achieving cost reduction, energy and resource savings in the long term, as well as increasing the level of Corporate Social Responsibility through the investment of green technologies.It should be noted separately that green technologies are not a trend inherent only in developed countries. Today, developing countries, including Uzbekistan, have begun to integrate the principles of the green economy into their development strategy. A number of programs are being implemented in the country to increase investments in renewable energy sources, improve the waste management system, develop environmentally friendly production. Projects aimed especially at solar and

wind energy justify themselves in terms of the point of economic efficiency.In today's global economic context, the popularization of green technologies is directly related to several important factors: firstly, to reduce the economic losses of climate change; secondly, to ensure stability in relation to the volatility of energy prices; thirdly, to increase competitiveness through new technologies and, fourth, to expand export opportunities by meeting international environmental requirements and standards. According to the International Energy Agency (IEA), decarbonization of the global energy system by 2050 requires about $ 4 trillion in investment each year, and the bulk of this investment will go towards green technology.In addition, innovative research and scientific research play an important role in the process of introducing green technologies. Modern technological trends such as digitization, artificial intelligence, big data analysis (big data analytics) are integrating with green technologies, further increasing their effectiveness. For example, energy consumption is optimized through smart grids (smart grids), water resources are saved and used through smart irrigation systems, and control of emissions and pollutants is enhanced through environmental monitoring systems.In general, green technologies are becoming an integral part of the current and future economic model. They provide opportunities to improve economic stability and efficiency, form new industries, and respond appropriately to global environmental calls, while providing environmental security. Therefore, an in-depth study of green technologies, the development of strategies for their introduction into various industries and the assessment of economic efficiency on their basis is one of the urgent scientific and practical tasks.

Green technologies () is a complex of modern innovative technologies created with the aim of protecting the environment, rational use of natural resources, reducing waste and increasing energy efficiency. The concept of green technologies is not only limited to the pursuit of environmental goals, but also serves to ensure economic efficiency, social well-being and sustainable development. After all, in the modern economic model, the limited nature resources and the need to prevent environmental pollution are making the use of green technologies a strategic necessity to ensure sustainable economic growth.

Green technologies are separated into the following main areas:

Green energy sources are energy resources from natural and renewable sources that reduce the negative impact on the atmosphere, water and soil layer. These sources include solar power, wind power, water power (hydropower), biomass and geothermal energy.

• Solar energy is obtained using solar panels and used to generate electricity and thermal energy.
• Wind energy converts kinetic energy into electricity through wind turbines.
• Hydropower uses the energy of the flow of water in rivers and bodies of water to generate electricity.

Biomass is energy from plant and organic waste and is used as an alternative to conventional fuels.

• Geothermal energy uses underground heat to obtain heat and electricity.

Today, the use of green energy sources covers an increasing part of global energy consumption. According to the International Energy Agency (IEA), as of 2024, 30% of global electricity is generated from renewable sources.

Energy efficiency technologies-serve to improve economic and environmental efficiency by optimizing the use of energy and reducing energy waste. These technologies include thermal insulation, energy-saving devices, and smart energy systems (smart grids).

• Thermal insulation reduces heat loss in buildings, which significantly reduces heating costs in the winter season and cooling costs in the summer.

• Energy-saving devices (for example, LED lamps, energy-efficient household appliances) reduce electricity consumption by at least 20-30 percent.
• Smart grids (smart grids), on the other hand, allow real-time monitoring and control of energy consumption, ensuring reliable and economical distribution of energy.
Through energy efficiency technologies, less resources are spent per kilowatt-hour in the production and consumption processes, which has a positive effect on the economy of enterprises and countries.
Waste recycling technologies
Waste recycling technologies are focused on the recycling and use of waste from industry, household and agriculture as secondary raw materials. These technologies cover the following main areas:
• Through the processing of plastic waste, materials such as polyethylene, polypropylene are reused in the production of new products.
• As a result of metal waste processing, iron, aluminum and other metals are involved in secondary production.
• Organic waste processing, on the other hand, is converted to fertilizers by composting and applied in agriculture.
These technologies make it possible to reduce the load on waste landfills, limit the emission of methane and other harmful gases into the atmosphere, and increase economic efficiency by saving resources.
Sustainable building technologies ("green buildings") is an innovative approach that aims to build environmentally friendly, energy efficient and health — friendly buildings.
• Green buildings include natural lighting and ventilation maximization, thermal insulation, renewable energy utilization, and water saving systems.
• The total energy consumption of the building is reduced through the use of energy-saving materials (e.g. multi-layer glazing, lightweight concrete, bamboo-based building materials).
Green buildings not only save energy, but also make it possible to improve the health of people living or working in the building, improve the quality of life and increase the market value of the building.
Environmental transport technologies are innovations in the transportation sector aimed at reducing carbon emissions and improving energy efficiency.
• Electric vehicles (electric cars) — reduce carbon emissions by almost zero degrees and reduce fuel costs.
Hydrogen engines-generate motion energy by burning hydrogen gas and generating only water vapor, and provide an environmentally friendly transport solution.
Currently, the market for electric cars is developing rapidly. According to the International Energy Agency (IEA), global electric car sales reached 14 million units in 2023, accounting for 18% of total car sales.
The impact of green technologies on economic efficiency is clearly visible through many measures, and their introduction is of urgent importance not only in terms of environmental benefits, but also in terms of the point of economic productivity. First of all, green technologies significantly reduce production costs. For example, the use of energy-saving technologies makes it possible for enterprises to reduce the cost of electricity and raw materials by 15-30 percent, which serves to strengthen competitiveness by increasing profitability and lowering the cost of production. Such an approach is of great importance, especially in the industrial and energy sectors, ensuring the stability of the production chain. On the second hand, green technologies have a direct impact on economic development by creating new professions and qualified jobs in

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the modern labor market. According to International Labour Organization (ILO) analysis, the number of "green jobs" worldwide is expected to exceed 24 million by 2030. This serves to increase employment, increase in population income, and strengthen social stability. Green technologies also play an important role in attracting the flow of foreign investment. The indicators of investments in sustainable production and environmentally friendly projects are increasing every year, since international investors are evaluating environmental sustainability as a key criterion in addition to financial stability. This situation has a positive effect on the economic stability of countries, making it possible for them to introduce new technologies, modernize infrastructure and improve international credit ratings. Finally, the large-scale implementation of green technologies serves to mitigate climate problems on a global scale. As a result, the environmental ratings of countries will increase and their image and competitiveness in international markets will be strengthened. This process not only brings environmental benefits, but also opens the door to new opportunities for economic growth. So, green technologies act as a solid bridge between economic efficiency and environmental sustainability.
Green technologies are being introduced in different economic sectors, providing specific economic and environmental efficiency in each sector. The application of green technology in the energy sector is particularly important, and the need for conventional coal, gas and oil is being significantly reduced through renewable energy sources such as solar panels, wind turbines and hydroelectric plants. For example, in the case of Germany, the fact that by the end of 2023 51% of electricity was received from renewable sources indicates serious achievements in this direction. As a result, energy production costs decrease, the volume of harmful gases released into the atmosphere decreases, and energy markets become more stable. And in the Transport sector, the development of electric cars and hydrogen fuel technologies is playing an important role. In particular, as a result of Tesla's activities, the market for electric cars has grown 8 times between 2015 and 2023, and is projected to account for 35% of global car sales by 2025. The widespread popularity of electric vehicles not only reduces fuel costs, but also has a positive effect on the health of the population by improving urban ecology. In the construction sector, the concept of "green buildings"is growing. LEED (Leadership in Energy and Environmental Design) certified buildings, while reducing energy consumption by 30-50 percent, maintain a 5-10 percent higher value at rental and sale prices compared to ordinary buildings when put on the market. This increases investment attractiveness in the construction business, providing long-term economic efficiency. And in agriculture, the use of intelligent irrigation systems and environmentally friendly fertilizers makes it possible to save up to 40 percent of Water Resources. For example, agricultural productivity doubled as a result of the introduction of drip irrigation technologies in Israel, which made it possible to ensure food safety even in conditions of water shortages. In general, the widespread introduction of green technologies across different economic sectors is taking the field as an important tool in transforming the modern economy and strengthening environmental sustainability.

Table 1

Economic Outcomes of Green Technologies Implementation

Sector	Green Technology Applied	Efficiency Result (%)
Energy	Solar and Wind Energy	Energy costs reduced by 25%
Transportation	Electric Vehicles	Fuel costs reduced by 70%
Construction	Green Building Technologies	Operational costs reduced by 30%
Agriculture	Smart Irrigation Systems	Water use reduced by 40%

As can be seen from the table, the widespread introduction of green technologies is providing significant economic efficiency in each sector. In the energy sector, the use of renewable energy sources such as solar and wind has reduced electricity production costs by an average of 25%, while in the transport sector, fuel costs have decreased by up to 70% due to the increased popularity of electric vehicles. In the construction sector, operating costs — i.e. costs associated with heating, cooling and energy consumption — have decreased by up to 30 percent with the help of" Green Building " Technologies. In the agricultural sector, however, intelligent irrigation systems have made it possible to reduce the use of water resources by up to 40 percent. These figures show that green technologies not only provide environmental safety, but also increase production efficiency, profitability of enterprises and farmers through tangible economic results, and dramatically improve the efficiency of resource use in the overall economic system.

In conclusion, it should be noted that green technologies are becoming an integral part of the economy of today and the future. In the context of Global climate change, resource shortages and environmental pollution, green technology is taking the field as a key factor in ensuring environmental security, economic stability and social welfare. Energy saving, rational use of natural resources, reduction and recycling of waste, as well as the formation of new innovative markets provide ample opportunities to increase economic efficiency through green technologies and implement sustainable development strategies. The implementation of green technologies even in the conditions of Uzbekistan has great ecological and economic potential. In particular, through the development of solar and wind energy, the expansion of the electric transport network, the development of the waste processing industry and the efficient use of water resources, not only Environmental Protection will be strengthened, but also the opportunity to move to a qualitatively new stage of economic development. Therefore, it is necessary to develop special programs for the popularization of green technologies at the government level, to provide benefits in taxation, to introduce mechanisms of financial incentives, as well as to encourage the private sector to switch to environmentally friendly technologies, as an urgent task. In addition, it will be advisable to strengthen the institutional framework of the green economy by increasing the ecological culture of the population and forming the need for green innovation. After all, through the widespread introduction of green technologies, the possibilities of ensuring an inextricable and balanced connection between economic growth and environmental sustainability expand, which is the main condition for future generations to maintain a stable and healthy environment.

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