

## SCIENTIFIC-THEORETICAL ISSUES IN THE FORMATION OF A GREEN ECONOMY

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**Abstract:** *The late 20th and early 21st centuries witnessed significant global changes, including transformative shifts that have profoundly impacted the world economy. Energy consumption plays a pivotal role in both the competitiveness of goods and the achievement of sustainable economic growth. In this context, the concept of a green economy has gained increasing prominence amid deepening globalization. Since the 2020s, rising carbon emissions have underscored the urgent need for enhanced decarbonization efforts. For the first time in history, global calls to prioritize decarbonization are surpassing concerns over energy security. This shift reflects growing ecological imbalances and environmental stress caused by excessive carbon emissions. During the mid-20th century, economic crises and geopolitical tensions were largely centered on controlling energy resources. While this led to the development of numerous oil and gas fields, contemporary challenges associated with traditional energy sources have accelerated efforts toward decarbonization. Global climate change further compounds these challenges, making the transition to renewable energy and green technologies imperative. The formation of a green economy is thus crucial to restoring ecological balance and fostering sustainable development.*

**Keywords:** *green economy, green technologies, renewable energy, non-renewable energy, green development, ecological balance, sustainable agriculture, water management, wind energy, hydro energy.*

### 1. INTRODUCTION

The concept of the green economy and the necessity for its development stem directly from the aforementioned arguments. It is worth noting that the term green economy was first introduced into economic discourse in 1989 by leading British economists David Pearce, Edward Barbier, and Anil Markandya (Pearce, Markandya, & Barbier, 1989). Research indicates that although these authors were the first to formally coin the term, discussions surrounding the need for a green economy can be traced back to the mid-20th century, driven by concerns over the excessive consumption of natural resources. In 1972, the Club of Rome published its seminal report, *The Limits to Growth*, which highlighted the depletion of natural resources, the negative environmental impacts of human activities, and the growing issue of waste (Club of Rome, 1972). Analyzing the report's findings, it becomes evident that the overuse of natural resources—particularly non-renewable ones—is predominantly associated with industrial production.

Consequently, the report's authors argue for imposing limits on industrial output, as such measures could ultimately reduce reliance on non-renewable resources. Scientific studies on the green economy suggest that David Pearce, a prominent British economist, is a leading figure in this field (Pearce, 1973, 1976). Pearce's works, including *Studies in Environmental Economics* (1973) and *Environmental Economics* (1976), lay the foundation for understanding the depletion of natural resources and the overall loss of biodiversity caused by anthropogenic impacts on the environment. In 1992, Pearce further explored the characteristics of the green economy, proposing that it represents a self-sustaining economic system. According to Pearce, sustainability is a defining feature of the green economy. Moreover, he posited that as the structure of the economy evolves—resulting in a decreased ratio of materials and energy used in the production of economic goods—its capacity for self-reproduction is enhanced (Pearce, 1992). Building upon Pearce's arguments, it can be inferred that distinct differences exist between the green economy and non-renewable economies. While both are inherently linked to nature, the green economy emphasizes sustainability and resource efficiency, contrasting with the finite resource consumption characteristic of non-renewable economies.

These are similar points; however, when focusing on the differences, it is important to note that the extraction of non-renewable energy resources, such as fossil fuels, leads to increased carbon emissions (Shkradyuk, 2010). Moreover, a defining characteristic of non-renewable energy resources is their expansion of anthropogenic impacts on the environment, resulting in continuous exploitation of natural resources (Ushakov, 2009). This exploitation diminishes the ability to preserve these resources for future generations, relegating their intergenerational sustainability to the background, particularly in terms of economic efficiency. Additionally, the use of non-renewable energy resources elevates carbon intensity, further exacerbating environmental degradation. (Hajiyeva, et al., 2024)

In contrast, as noted by David Pearce, a defining feature of the green economy is its reliance on renewable and self-reproducing economic systems (Pearce, 1992). The green economy is essentially a subset of ecological economics, which, although a relatively recent field, emphasizes the intricate relationship between nature and society. Ecological economics is currently in a developmental phase, with foundational contributions by scholars such as Robert Costanza and Herman Daly (Costanza, 1991; Daly, 1991). Their joint monograph, *The Scientific and Managerial Basis for Sustainability of Ecological Economics*, published in 1989, underscores the critical role of economic mechanisms in preserving nature and biodiversity (Costanza & Daly, 1989). Viewed from this perspective, it is arguable that the foundational ideas of the green and ecological economy trace back to the early 20th century, with significant contributions from the Ukrainian biologist and former Soviet scientist V. I. Vernadsky (Vernadsky, 2004). Vernadsky's early work on environmental conservation laid the groundwork for sustainable resource management, emphasizing the efficient use of natural resources and their preservation for future generations. His contributions can be regarded as the rudimentary basis for the development of the green economy.

The conceptual foundations of the green economy began to gain momentum in the late 20th and early 21st centuries. These foundations are closely linked to the fundamental principles of sustainable development. Notably, the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro adopted the concept of sustainable

development (United Nations, 1992). This was followed in 2012 by the "Rio+20" Conference, which produced the *Future We Want* declaration. The declaration highlighted the interconnectedness between the green economy and sustainable development, emphasizing the critical role of a sustainable future in eradicating poverty (United Nations, 2012).

The declaration took a conceptual approach to the green economy within the broader framework of sustainable development, asserting that the green economy is a tool for achieving sustainability. It also called for global cooperation, advocating the exchange of best practices, the application of various models and technologies, and the sharing of methodologies for assessing green economy development strategies. Both the 1992 and 2012 UN conferences identified three fundamental pillars for sustainable development: economic growth, social efficiency, and ecological balance. In this context, the green economy is most closely aligned with the first and third pillars. Ensuring ecological balance, a core objective of the green economy, is central to its mission.

The use of green technologies aims to ensure economic growth while reducing environmental harm, including carbon emissions, which is reflective of the world's ecological stability and sustainability. From this perspective, it can be argued that significant progress has been made in the conceptual foundations of the green economy, particularly from the late 20th century and into the early 21st century. Efforts to address the impacts of global climate change on countries have continued systematically. Since the 1990s, the growing focus on the economic and socio-economic implications of climate change, along with coordinated international efforts, has become an imperative. In this regard, the UN Framework Convention on Climate Change was adopted in 1995, and the first Conference of the Parties (COP) meeting was held in Berlin in the same year. The hosting of COP29 in Baku, Azerbaijan, is significant, not only in terms of enhancing the country's international image but also as an important contribution to the advancement of green economy initiatives.

As mentioned previously, the green economy aims to reduce carbon emissions. In this context, Article 6 of the Paris Agreement, within the COP framework, notes that implementing national climate plans can result in savings of up to 250 billion USD annually. Although the formation of the green economy plays a crucial role in ensuring ecological balance, it must be acknowledged that the process is complex and multifaceted. This involves, first and foremost, the limitation of the use of non-renewable energy resources, the establishment of ecological balance, and the significant reduction of harmful carbon emissions, all of which require substantial financial investment. A key aspect of establishing the green economy is the transition to green energy sources and technologies across all sectors of the economy.

## ***1.2. The classification of sectors hindering economic development and shaping the green economy.***

Households, particularly in developing countries, are significant contributors to environmental pollution, especially by carbon dioxide. Additionally, the release of waste pollutants from households into the environment often leads to harm to both soil and air resources (UNEP, 2016). In developing countries, households tend to rely more on traditional energy resources. For example, in cities, fuel and energy resources such as natural gas are commonly used, which results in the emission of carbon dioxide into the atmosphere (IEA,

2018). To eliminate carbon dioxide emissions from households, it is essential to first transition the technologies used in households to renewable energy sources (World Bank, 2020).

The second sector hindering the green economy is the transportation sector. The use of diesel fuel and gasoline in automobiles, particularly in developing countries, increases the release of carbon dioxide into the environment (International Transport Forum, 2021). The industrial sector also has a significant contribution to this issue, as industrial activities in both developed and developing countries cause environmental pollution, including contamination of soil, air, and water (UNIDO, 2018). These sectors require fundamental changes. For example, when analyzing the carbon emissions released by these sectors in Azerbaijan, it can be concluded that the consumption of non-renewable energy resources in household accounts for 33.5%, in the transportation sector 23.5%, and in the industrial sector 13.5% (Ministry of Ecology and Natural Resources of Azerbaijan, 2020).

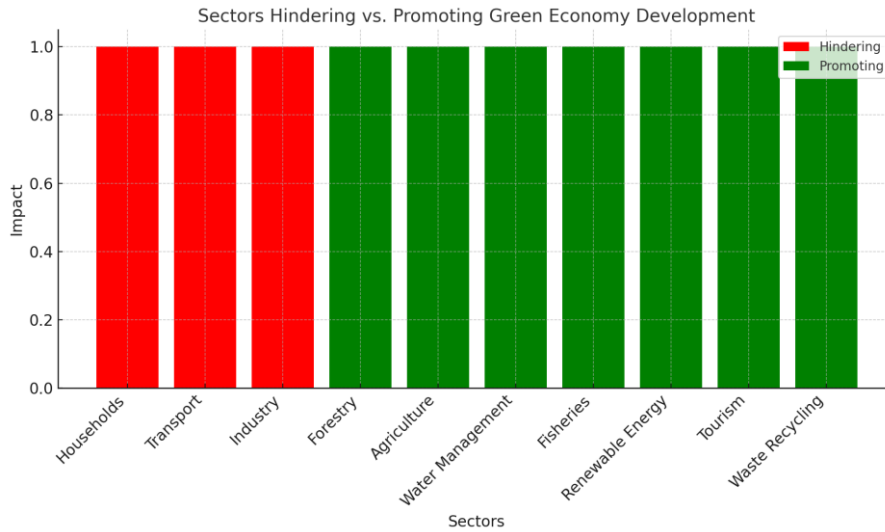
The remaining consumption of non-renewable energy resources is observed in other sectors. It can be argued that, with the exception of the industrial sector, there are potential resources available to limit the consumption of non-renewable energy sources in other sectors. For example, to reduce the consumption of non-renewable energy sources such as oil and gas in households, it is crucial to improve household technologies, upgrade gas pipelines, and install solar panels on homes, which would help reduce carbon emissions (IRENA, 2019). Similar trends can be observed in the transportation sector. For instance, customs duties on electric vehicles entering the country have been reduced to zero, and there are also lower customs duties for hybrid vehicles (Azerbaijan State Customs Committee, 2022). However, challenges still remain in this sector. The number of battery charging stations for electric vehicles is still quite low, and the widespread installation of charging stations in residential areas could create significant opportunities for the sector (ADB, 2021).

As for the industrial sector, since it is primarily composed of the oil and gas sector and the chemical industry in Azerbaijan, it is expected that problems in this area will persist for a certain period. There are also sectors that stimulate the development of the green economy, or more specifically, form the green economy. These sectors include:

- Forestry;
- Agriculture;
- Sustainable water management;
- Fisheries sector;
- Renewable energy sources;
- Tourism sector;
- Waste recycling process.

Regarding forestry, it is important to note that forests absorb carbon dioxide and release oxygen into the environment, playing a crucial role in preventing soil erosion. Forestry is essential for the protection of ecosystems. Therefore, actions such as preventing deforestation and protecting forests from fires could serve as traditional methods for safeguarding the green economy.

**Figure 1**  
*Showing the classification of sectors that either hinder or promote the green economy*



Source: Author’s own analysis based on the classification of sectors hindering and promoting green economy development, derived from the provided content on the topic.

Agriculture, which plays a vital role in meeting the food demands of the population, also has a key role in preserving biodiversity. If agriculture focuses on low-water consumption crops, reduces agrochemical loads, implements integrated pest management, and employs anti-erosion technologies, it can significantly contribute to the green economy. Therefore, it is necessary to implement the required measures for the development of green agriculture and increase government subsidies for the development of ecological farming. Water management also plays an important role in the development of the green economy. Balancing water usage, particularly preventing wasteful use of water resources, can significantly help in the case of water scarcity. Additionally, the recycling of used water, except for potable water, can play a critical role in meeting the water demands of other sectors. It is known that agriculture accounts for approximately 70% of total water usage. Therefore, efficient use of water resources should be emphasized.

Fishing, particularly in natural and artificial fisheries, can provide a source of income for the population. Additionally, the development of fishing can contribute to the protection of ecosystems and create favorable conditions for expanding renewable energy resources. Thus, attention should be given to preventing the sharp decline in fish stocks. As for waste management and recycling, this sector plays a significant role in reducing carbon emissions. Moreover, it also lowers production costs, ensures the availability of raw materials, and, in our opinion, the waste recycling sector can be a source of the green economy while increasing the competitiveness of produced goods.

## 2. DISCUSSIONS AND RESULTS

The use of green technologies primarily serves to reduce the cost of living within social categories, that is, to prevent social inflation. The calls for the use of green technologies in everyday life have become particularly relevant in recent times. These calls also include the utilization of renewable energy sources and the use of low-cost energy resources based on high

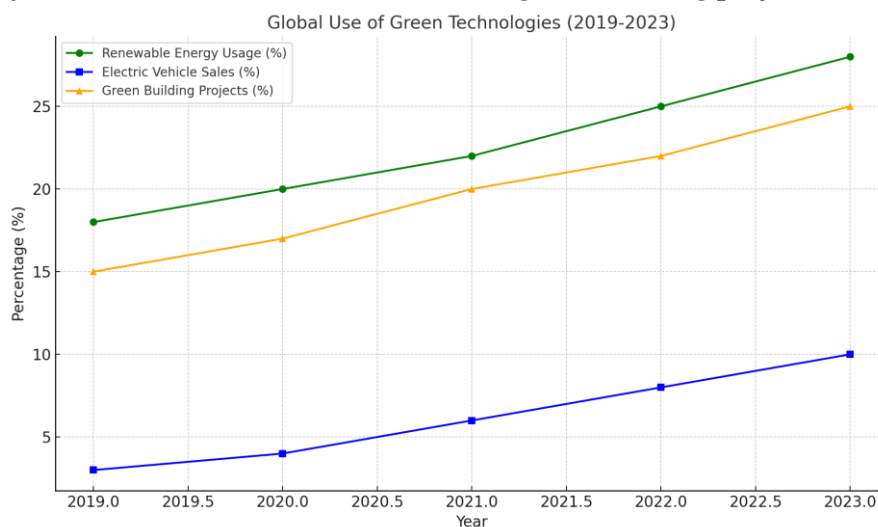
technologies. One of the key factors conditioning the objective necessity of using green technologies is, first and foremost, the issue of limited resources, which is one of the fundamental economic challenges. The use of limited resources ultimately leads to the high cost of resources and the high production costs of manufactured goods. The application of green technologies serves, above all, to produce more competitive products economically. In this regard, the application of resource-saving technologies and the use of technologies related to the recycling of resources are crucial. Moreover, the diversity of resources aimed at recycling increases the attractiveness of this process.

As is known, resources are divided into renewable and non-renewable energy sources. Therefore, the resources that have been consumed should be differentiated not only based on their consumption but also in terms of their resource potential. In this context, one of the most significant factors that makes the use of green technologies an objective necessity is the elimination of the harmful effects of anthropogenic emissions on the natural environment. The use of low-waste production technologies not only enhances the efficiency of energy equipment but also reduces the consumption of various material resources as well as the level of harmful emissions. The fundamental basis of green technologies is natural resources. In this regard, green technologies include wind energy, solar energy, hydro energy, geothermal energy sources, as well as biofuel production technologies and energy efficiency technologies.

As productive forces and production relations develop within society, and with the deepening of the globalization process, the anthropogenic impacts on nature are intensifying. Among the most significant problems humanity faces today are environmental pollution, the depletion and poor restoration of natural resources, and issues like hunger. The rapid and efficient solution of these problems will directly depend on the application of green technologies and the formation of a green economy. One of the characteristic features of green technologies is the application of environmentally clean production processes with low carbon emissions. All of these elements play an important role in various sectors of the economy, including households, industry, construction, transportation, and agriculture.

**Figure 2**

***The trends for three key areas: the percentage of energy from renewable sources, the sales percentage of electric vehicles, and the increase in green building projects***



Source: IEA website.

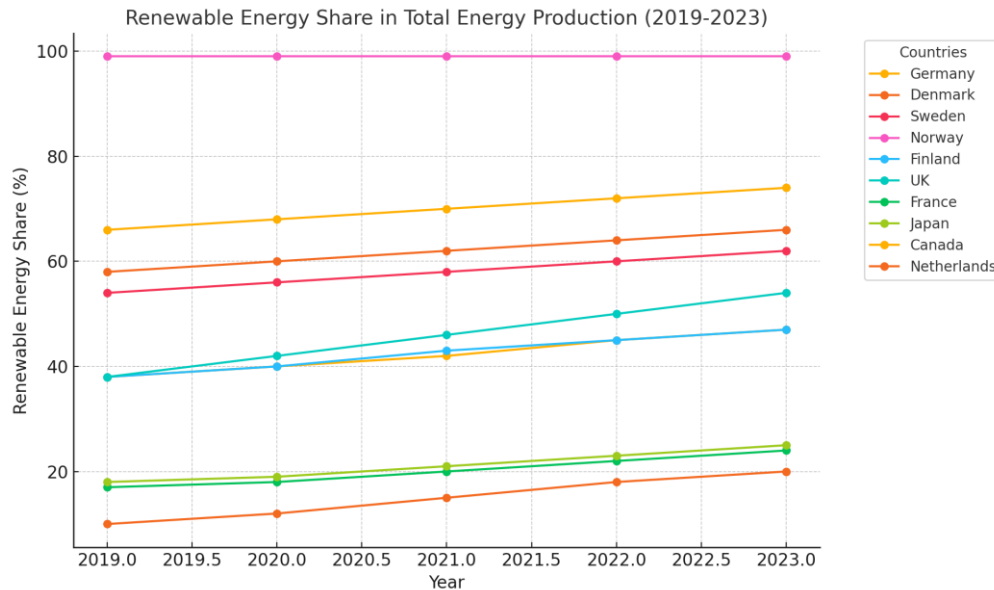
Thus, focusing on the application of green technologies from a single perspective, such as reducing carbon emissions through the use of solar, water, and wind energy, would not, in our view, provide a comprehensive understanding. The application of green technologies should be approached in a more complex, multifaceted manner. Green technologies are aimed at reducing environmental pollutants, producing ecologically clean products, and applying less harmful production processes. Green technologies also include issues such as waste recycling, air and water pollution, soil restoration, the reduction of harmful emissions into the atmosphere, and the production of alternative energy sources, among other factors. (Muradov & Hajiyeva, 2024) The use of traditional technologies, or more specifically, non-renewable energy resources, primarily leads to an increase in the energy consumption of the produced goods. It is no coincidence that, particularly in post-Soviet and post-socialist countries, the cost of goods produced is higher compared to their counterparts produced in developed countries, primarily due to the higher energy consumption. All of this results in a decrease in the competitiveness of the produced goods. From this perspective, the application of green technologies has its own unique advantages, which can be classified as follows:

- Recycling of waste generated during the production process and ensuring its use;
- Reduction of energy consumption and the decrease in the energy cost of production;
- The use of green technologies leads to a reduction in carbon emissions into the environment, which ultimately prevents air and environmental pollution;
- The use of clean water resources and the implementation of water recycling;
- Stimulating the offer of competitive commodities in the global market;
- Creating favorable conditions for stimulating economic development.

As for the first advantage of using green technologies, it should be noted that recycling waste ultimately leads to the offering of cheaper products in the market. This is one of the reasons why China now has the capacity to produce sufficiently competitive products for the global market. In China, the use of waste materials has significantly reduced the share of raw material costs in the structure of production costs. It is no coincidence that several companies and firms that export products to the global market now prioritize environmentally friendly alternatives. In this regard, products are being made from recycled paper, plastic mass, fabrics, glass, organic materials, metals, and even asphalt scraps. Overall, modern global economics increasingly favors the production of goods based on recycling, which is particularly important in reducing the production cost of goods. The importance of the recycling process is primarily significant in terms of reducing the amount of waste and the decreased use of raw materials. The recycling process, after the utilization stage, opens up vast opportunities for producing more environmentally friendly products. (Humbatova et al., 2024)

**Figure 3**

*The renewable energy share in total energy production for the top 10 developed and developing countries over the past 5 years (2019-2023).*



Source: IRENA and World Bank

It can be said that not only in developed countries but also in the markets of developing countries, products made from recycled materials are increasingly preferred. For instance, in stores, one can already see bags made from recycled plastic, packaging materials made from cardboard or paper, which, in addition to being environmentally friendly, also incur lower production costs. In other words, their production costs are lower, making these products more competitive in the market (Pearce, Markandya, & Barbier, 1989).

The second factor driving the superiority of green technologies, as mentioned above, is the reduction of energy consumption through their application. This, in turn, contributes to the decrease in the use of non-renewable energy resources, including hydrocarbons. The excessive consumption of limited resources has become one of the most pressing issues of the modern era. This process also creates favorable conditions for the reduction of harmful carbon emissions into the atmosphere (Costanza, 1991). It is also important to note that non-renewable energy resources are primarily used in sectors such as industry, mining, transportation, and households. The use of non-renewable energy sources results in increased carbon emissions, which, in turn, leads to environmental pollution. Particularly in urban areas, the intensive use of transportation vehicles accelerates the consumption of non-renewable energy resources, thereby generating significant carbon emissions. As noted earlier, one of the key advantages of green technology is its contribution to water purification and recycling.

In addition to carbon emissions, water pollution and the scarcity of water resources have become critical global concerns. For instance, one in every nine people on Earth lacks access to clean drinking water near their living areas. Consequently, many developed firms worldwide are prioritizing water recycling and reuse. After the initial use of water, purification and recycling processes are carried out, allowing water to be repurposed for non-potable uses such as irrigation, cleaning sanitation systems, washing vehicles, firefighting, and meeting the water demands of other economic sectors (Brodach, 2022).



Another advantage of green technology is its role in enhancing the competitiveness of products. The use of traditional resources typically increases the production cost of goods, whereas recycling waste leads to the creation of more competitively priced products, making them more accessible to consumers. Green technologies contribute to reducing production costs, thereby fostering more affordable products for consumers (Piskulova, 2013). The final advantage discussed is the stimulation of economic development. The use of green technologies plays a crucial role in modernizing economies and applying advanced technologies. In particular, the recycling of waste leads to the production of various products that are safe for humans and can, in some cases, become branded goods. The application of green technologies in developing countries could create favorable conditions for their rapid development, and in this regard, China's experience could be especially beneficial.

### **3. CONCLUSIONS**

The experiences of developed countries show that the application of green technologies, as a crucial component of the green economy, is widespread, particularly in Scandinavian and Northern European countries. For example, Iceland is a global leader in green energy production per capita, accounting for 80%. In Sweden, a significant portion of investments is directed toward the application of green technologies. This includes investments in ecologically clean transportation and renewable energy sources like solar and wind power. Denmark has implemented measures to phase out non-renewable energy sources almost entirely by 2050. In 2014, Denmark achieved a near-world record by sourcing nearly 40% of its total energy from green energy (Vernadsky, 2004).

As green technologies enhance the competitiveness of the products they are used to produce, member countries of organizations like the OECD pay increasing attention to boosting their budgets for scientific research in both energy and environmental protection. In these countries, state expenditure on green energy accounts for approximately 5%, and in European Union member states, this figure exceeds 7%. The highest proportion is found in New Zealand (14%) and Japan and Korea (12-13% in 2012). In contrast, countries like the U.S., Russia, Switzerland, and Israel allocate less than 2% of their state budget to the implementation of environmental technologies. Additionally, the U.S. spends slightly more than Japan on green technologies, with \$4.2 billion allocated to environmental protection, compared to Japan's \$3.7 billion (United Nations, 2012).

Developing countries are also increasing their focus on environmental protection through green ecological technologies. In China and India, for instance, state expenditures on these technologies are on the rise. China currently has over 1,600 government-owned incubators and scientific parks, most of which are involved in green technology projects. The country has become a global leader in six key sectors, including wind energy, biofuels, and clean coal, with the most significant patents in these areas (Piskulova, 2021).

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