INVESTING IN THE GREEN ECONOMY: AN ANALYSIS OF RISKS AND OPPORTUNITIES

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Abstract

The green economy, focused on sustainable development and reducing environmental impacts, has become an increasingly attractive area for investment. This paper provides an in-depth analysis of the opportunities and risks associated with investing in the green economy. Key sectors examined include renewable energy (solar, wind, and bioenergy), sustainable agriculture, electric vehicles, energy efficiency technologies, waste management, and carbon capture solutions. The analysis explores how these sectors are benefiting from global trends such as climate change mitigation policies, corporate commitments to carbon neutrality, technological innovations, and growing consumer demand for sustainable products and services. On the opportunity side, investors stand to gain from significant market growth, government incentives, and regulatory frameworks such as carbon pricing and renewable energy targets. For example, renewable energy is becoming more cost-competitive with fossil fuels, and electric vehicle sales are projected to rise as countries phase out internal combustion engines. Green bonds and environmental, social, and governance (ESG) criteria have also opened new financing channels for green projects, providing investors with diversified portfolios that align financial performance with positive environmental impact.

Keywords: green technologies, sustainable agriculture, electric vehicles, carbon capture, regulatory risks, green bonds

I. Introduction

The transition to a "green" economy and its models, global divestments in the world (redistribution of investments from non-ecological and high-carbon sectors to low-carbon sectors), support for new technologies, "green" financing, etc. can significantly increase financial support for the greening of the economy. A significant reserve for investments in the "green" economy can be the elimination of various types of subsidies and grants for nature-exploiting sectors. For example, the "brown" economy relies to a significant extent on traditional types of fuel. The total amount of subsidies for the production and consumption of fossil fuels in the world has exceeded 400 billion US dollars per year, which hinders the improvement of energy efficiency and the wider use of renewable energy sources (see Section V). There are many obstacles to the formation of a "green" economy, including those associated with widespread stereotypes. Thus, perhaps the most widespread is the myth of the existence of an inevitable contradiction between environmental sustainability and economic progress. There is now ample evidence that greening the economy does not hinder the creation of wealth or jobs, and that investment in many green sectors is a source of increased financial well-being and employment. However, the transition to a green economy requires the creation of new conditions, and this requires large-scale and urgent action by governments in all countries of the world. It is also often said that a green economy is a luxury that only rich countries can afford, or, even worse, that it is something that developed countries

impose on developing countries so that the latter will remain poor forever. Modern research, including that of international organizations, provides many examples of the transition to a green economy in various sectors of the developing world that refute this idea - examples that deserve to be repeated in other parts of the world. Research also convincingly shows that greening the economy may not be a brake, but a new stimulator of development. The transition to a green economy is impossible without the economic benefits of such a course for public and private enterprises. It is difficult to make the economy "green" using only legal regulators and administrative measures, as shown by the global experience of the last decades. Among the main reasons for the negative impact of the economy on the environment, one can note the latency (secrecy) of a large number of environmental problems; the traditional market simply does not see them. The modern economy cannot accurately determine the benefits, damages and prices for the environment, "digitize" and economically present environmental problems for the government, business and society. To make greening profitable, at least three levers are needed: 1) stimulation of greening of the economy.

II. Methods

The European Investment Bank has identified three main reasons for the need to transition to a circular economy:

1. Resource constraints. Global demand for resources is increasing rapidly, leading to a growing deficit of critical raw materials and water.

2. Technological development. The introduction of new technologies enables the creation and implementation of circular economy business models. Without technological advancements and innovative approaches, it would be impossible to recycle, replace, and reuse resources, or to leverage new IT technologies.

3. Socioeconomic development. Circular models play a crucial role in the context of increasing urbanization. Urban areas are well-positioned to develop, implement, and maintain systems that can efficiently collect and return goods, materials, and other resources, leading to cost savings.

A fourth reason can be added—**environmental considerations**. Unused production and consumption waste occupies significant land areas, while pollutants migrate into the air, groundwater, and surface water, causing harm to public health, agriculture, and natural resources. These negative externalities lead to substantial environmental damage, including socioeconomic impacts. The circular economy must internalize these externalities and aim to minimize all forms of harm.

Potential future resource constraints due to rising global demand are also highlighted in OECD forecasts. Over the past few decades, the demand for resources has surged due to rapid industrialization in emerging economies and the growing needs of developed countries. Since 1980, global consumption of various materials has more than doubled. This trend is expected to continue, driven by population growth—from 7 billion people today to approximately 10 billion by 2060—accompanied by rising incomes and demand. According to OECD projections, if current trends persist, global use of material resources will rise from 79 billion tonnes in 2011 to 167 billion tonnes by 2060. Demand for metals, in particular, is forecast to increase from 8 billion tonnes to 20 billion tonnes by 2060, or 2.5 times.

The goal of the circular economy is to establish closed ecological and economic cycles, making the most efficient use of incoming raw materials in production processes, minimizing waste generation, and integrating accumulated waste back into economic activity. This approach aims to replicate natural cycles through environmentally compatible technologies across industries and responsible consumption models, forming analogs of ecosystems. The biosphere is a closed system where all elements are interconnected, and no waste is generated. In contrast, the modern technogenic economy operates as a linear, open system, where the production of a

relatively small final product requires vast resource consumption and generates large amounts of waste. Currently, only 2-6% of the total volume of extracted natural matter becomes a final product, with the remainder becoming waste (e.g., tailings, slag, wastewater, etc.).

Humanity is familiar with relatively closed economic systems, such as traditional agriculture. In this system, waste is minimized: agriculture supplies livestock with feed, including byproducts from crops like grains, sunflower, and sugar beet, while livestock, in turn, provides agriculture with organic fertilizers that enhance soil fertility. This creates a more or less closed cycle of materials, resembling natural ecosystems.

III. Results

One approach to assessing the effectiveness of a circular economy can be the product recycling rate. It can be determined using the following formula:

$$r = Rr / Ra,$$

where r is the product recycling rate, Rr is the volume of recycled waste, Ra is the total volume of waste.

Traditionally, materials such as glass, paper, cardboard, and aluminum (e.g. packaging and containers) are recycled around the world. In some countries, the recycling rate of these materials exceeds 0.9. However, in Russia, this figure is significantly lower.

Assessing the effectiveness of the transition to a circular economy and the costs associated with it is an important issue. The benefits of transitioning to such a model include the recycling of resources, energy production from waste, and other forms of reducing environmental impact. Although the introduction of low-waste technologies may be costly, taking external costs into account can significantly increase overall efficiency.

Waste and pollution have a significant negative impact on human health and lead to environmental degradation. Therefore, choosing "cheap" solutions that require minimal initial investment can result in large social losses. For example, an important problem is the disposal of solid municipal waste. If it is solved using simplified incineration technologies, this can lead to significant harm to public health due to emissions of dioxins, particulate matter and other harmful substances. Positive and negative externalities (external effects) of the development of a circular economy are presented in Table 1. There may be a certain symmetry between positive and negative externalities. For example, a reduction in the extraction and use of renewable and non-renewable natural resources, which reduces the burden on the environment, can simultaneously lead to a decrease in income and employment in sectors engaged in the exploitation of natural resources.

Table 1: *Externalities of the development of the circular economy*

Positive Externalities	Negative Externalities
Reduction in the extraction and use of renewable and non-renewable natural resources	Additional consumption of resources and energy during recycling of products and waste
Reduction of negative environmental and health impacts from waste, including decreased landfill areas	Decrease in revenues for natural resource exploitation sectors
Development of resource-saving technologies	Reduction in employment in natural resource sectors
Creation of additional jobs	Potential negative health impacts from improper waste disposal (e.g., low-tech waste incineration)

IV. Discussion

Limited resources and investments in the economy necessitate prioritizing certain areas in the transition toward sustainable development and the formulation of environmental and economic policy. A common demand today is for a substantial increase in environmental protection expenditures. Typically, these costs are compared to total investments in the economy, gross domestic product, or benchmarked against those of developed countries. However, environmental protection costs are often narrowly defined, referring only to direct measures such as treatment facilities, filters, reclamation projects, and similar initiatives. This approach is incomplete and flawed.

Investments should be directed where they will yield the greatest environmental and economic returns and prove most effective. So, what should be considered environmental protection costs in this context? In a resource-intensive, raw material-based economy, priority should be given to structural and technological transformation, focusing on the development of low-emission technologies. This approach would help withdraw large volumes of inefficiently used natural resources from active circulation and alleviate the environmental burden.

To frame it differently, current investments should be divided between addressing immediate issues (i.e., direct environmental protection measures) and ensuring long-term sustainability (mainly through structural and technological shifts, such as adopting best available technologies—BAT). By investing in the resource-saving structural and technological transformation of the economy, making it more sustainable, and reducing its natural resource intensity, we can simultaneously minimize the costs of addressing the negative environmental impacts of industrial economic development.

It is challenging to justify the need for simply increasing environmental protection costs, as financial resources are always limited in the economy. Instead, it is crucial to demonstrate the high economic efficiency of environmentally-oriented measures, even if these benefits are not immediately obvious. This is achievable when accounting for the true economic value of nature and ecosystem services (as discussed in Section III). In a transforming economy, unlike in developed economies, there is a significant opportunity to capture substantial environmental benefits ("ecological cream") through purely economic structural projects and programs.

The primary focus should now be on economic policies that offer a "double win"—policies that generate both economic gains and significant environmental benefits. These include modernization, the spread of innovation, energy conservation, and the development of high-tech, infrastructure, and manufacturing industries. In other words, economic measures should simultaneously produce associated positive effects in the ecological sphere.

The global green economy, encompassing markets focused on climate and environmental solutions, has seen substantial growth over the last decade, presenting a compelling investment opportunity. In 2023, it rebounded strongly after a decline in 2022, with its market capitalization reaching $7.2 trillion by Q1 2024. Despite its recovery, challenges remain, including issues of overcapacity and trade barriers in renewable energy and electric vehicle (EV) manufacturing. Downsizing at several major U.S. green companies in early 2024 caused the green economy's share of the overall market to drop slightly from 8.9% at the end of 2023 to 8.6% in early 2024.

Despite these hurdles, the green economy continues to grow, with a long-term compound annual growth rate (CAGR) of 13.8%, outpacing the broader stock market. If treated as an independent sector, the green economy would have ranked as the second-best-performing industry over the last decade, only surpassed by the technology sector. For example, in 2023, the FTSE Environmental Opportunities All Share (EOAS) Index, a key measure of green economy performance, rose by 32%, compared to the 22% rise in the broader FTSE Global All Cap Index.

Since its inception in 2008 through March 2024, the EOAS has outperformed the benchmark index by 82%.

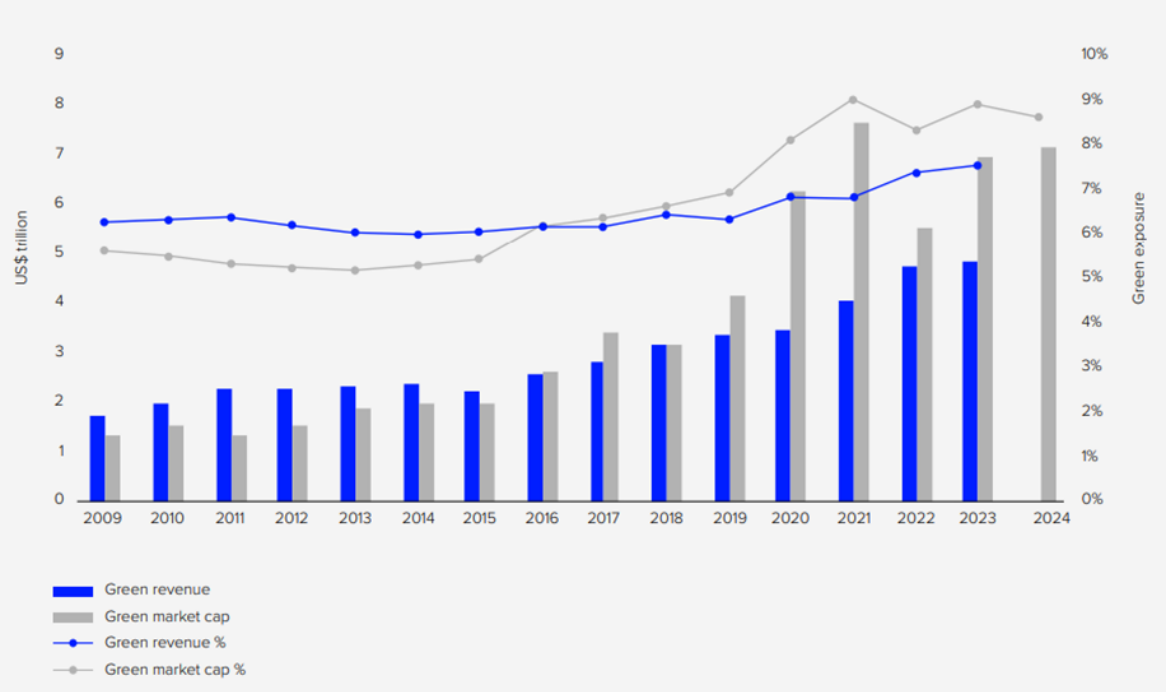

Figure 1: *Green economy 2009–2024*

However, not all green sectors have performed equally. The energy efficiency sector, which includes technologies such as efficient IT equipment and green buildings, has been the most successful, making up 46% of the green economy and generating 30% of green bond proceeds. In contrast, the renewable energy sector has lagged and underperformed in 2023, highlighting the uneven distribution of growth within the green economy.

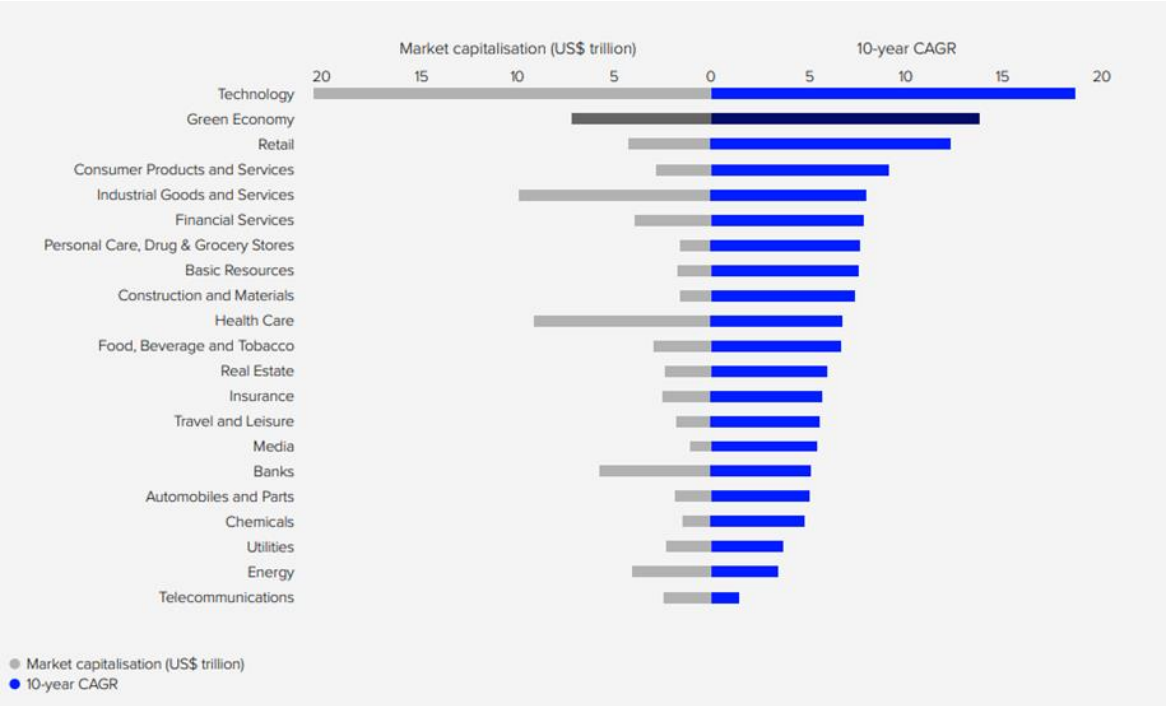

Figure 2: *Market capitalisation value and 10-year growth rate – Green Economy compared with ICB sectors*

If viewed as a standalone sector, the listed portion of the green economy in 2023 would have generated annual revenues nearing $5 trillion, with a market capitalization exceeding $7 trillion. This positioning would make it the fourth largest sector globally, surpassing industries such as Banks, Retail, and Energy, but still trailing behind Health Care, Industrials, and Technology.

Over the past decade, in terms of growth and financial performance, the green economy has only been outpaced by the Technology sector. If represented by the FTSE Russell Environmental Opportunities All Share Index (EOAS) and categorized as a separate ICB Industry, it would have ranked as the second-best-performing industry over the past ten years. Since 2008, the EOAS has consistently outperformed the broader FTSE Global All Cap Index by 82%, with significant outperformance occurring in 2020 and 2021.

The market capitalization of the green economy has expanded at a compound annual growth rate (CAGR) of 13.8% over the last ten years, compared to 8.3% for global equity markets. Revenues from the green economy have grown at a CAGR of 7.6% over the same period, exceeding the growth rate of combined revenues from all other companies (5.3% CAGR).

Within the green economy, the Energy Management and Efficiency sector has been the largest and highest-performing segment. Growing at 17% CAGR over the past five years, it now represents 46% of the green economy's listed equities and accounts for 30% of the proceeds from green bonds. This sector has driven the overall outperformance of the EOAS, leading ahead of other green sectors like Water and Renewable Energy.

A successful transition to a low-carbon economy requires a profound economic transformation, involving substantial mobilization of private finance. Achieving net-zero carbon emissions by 2050 is projected to necessitate additional global investments ranging from 0.6% to 1% of annual global GDP over the next two decades, equating to a cumulative total of $12 trillion to $20 trillion (IEA 2021; IMF 2021a). These investments must shift away from the fossil fuel sector towards renewable energy and low-emission technologies across various sectors. Therefore, a significant and urgent green investment push is essential to facilitate this transition (as outlined in the October 2020 World Economic Outlook).

The global financial sector is positioned to play a critical role in catalyzing private investment to accelerate the transition. In recent years, sustainability concerns—including environmental, social, and governance (ESG) factors—have increasingly become integrated into investment strategies, driving the growth of sustainable finance (October 2019 Global Financial Stability Report). Investors focusing on sustainability may have dual objectives: financial returns ("doing well" by accounting for sustainability's growing importance for profitability) and advancing sustainable economic development ("doing good," particularly by supporting a faster transition to a low-carbon economy).

Achieving net zero will likely require an annual investment of US$1 to $2 trillion in real terms, or about 1% to 2% of global GDP (see Figure 3). This level of spending would far exceed previous major economic stimulus initiatives, such as the Marshall Plan (equivalent to US$114 billion today). Moreover, the decarbonization effort will be a long-term endeavor, requiring sustained capital expenditure for at least the next two decades. With capital investment representing 7% to 14% of total global investment annually, the intensity of capex as a share of global GDP will reach around 28%—a level not seen since the global financial crisis or the 1970s. This combination of massive spending, supportive policies, and evolving consumer and investor preferences is expected to trigger a new capital cycle.

Government commitments to decarbonization, such as the recently passed US$1.2 trillion U.S. infrastructure plan and the European Green Deal, are playing a critical role in legitimizing and accelerating the green capital expenditure (capex) cycle:

- Governments are framing investment in the low-carbon transition as a key tool for economic recovery. Renewable energy projects, like solar, wind, and hydro, are more

labor- and capex-intensive than traditional power generation, making them effective at creating jobs and stimulating economic activity.

- Consumers, increasingly aware of the physical and financial risks of unchecked climate change, are pressuring policymakers and investors to take meaningful action.
- Rising geopolitical tensions are pushing governments to prioritize energy security, climate-tech leadership, and resilient supply chains. The development of regional supply chains for electric vehicles (EVs), batteries, and critical raw materials will further drive capital investment by duplicating supply chains.

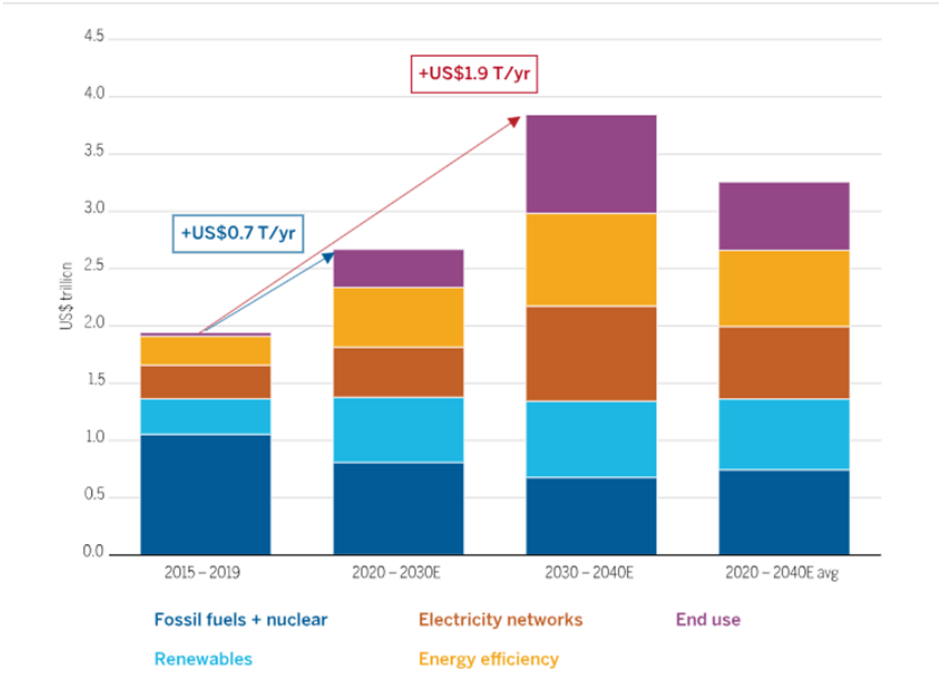

Figure 3: *Spending needed to achieve net-zero emissions by 2040*

Within the broader landscape of sustainable finance, the investment fund sector is particularly noteworthy due to its growing size and emphasis on sustainability-related issues. The sector has expanded substantially since the global financial crisis and now comprises around one-third of the assets held by nonbank financial institutions. It is at the forefront of incorporating sustainability considerations, including climate change mitigation, into investment decisions. This trend is evident from the increasing number of investor and asset manager networks committing to decarbonization efforts and integrating sustainability into their strategies.

Recent survey data and research indicate that investment funds, particularly those with a sustainable investment mandate, are increasingly attentive to climate change and the green transition. Financial markets have begun to reflect the pricing of the transition, which is crucial to steer capital toward firms and projects that positively impact climate change mitigation while avoiding overinvestment in non-sustainable ventures.

However, while the investment fund sector plays a pivotal role in advancing the green transition, financial stability risks associated with this transition are also significant. The path to a green economy remains uncertain, with variations across countries based on differing policies, adoption of clean technologies, and shifts in consumer and producer preferences towards low-emission products and services (October 2019 Fiscal Monitor; October 2020 World Economic Outlook). Transition paths could offer opportunities for high-return investments but also present risks, particularly for firms in sectors vulnerable to cleaner technologies (e.g., fossil fuels, energy-intensive industries).

Studies have documented the substantial exposure of investment funds to sectors most sensitive to the transition, such as fossil fuels, utilities, and energy-intensive manufacturing. A sudden transition shock, such as the rapid realization of the need for swift global change, could lead to a sharp repricing of these assets, potentially triggering financial stability risks.

This paper explores the interaction between the global investment fund sector and the transition to a low-greenhouse-gas economy, addressing two key questions: How do sustainable investment funds, which pursue both financial and sustainability objectives, support the transition? And what has been the impact of transition shocks on the investment fund sector so far? To answer these questions, the chapter develops a conceptual framework that examines the interlinkages between the investment fund sector and the green transition. Using a dataset of more than 54,000 open-end funds—including equity, fixed-income, and allocation funds—it conducts empirical analysis to assess the role of these funds in facilitating the transition and how they have responded to transition-related risks.

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