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Green Entrepreneurship Strategies: Integrating Eco-Friendly Energy Technologies with the Digital Economy

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Abstract

Integrating innovation, energy-saving technologies, and the digital economy is crucial for achieving sustainable development, increasing competitiveness and ensuring a high quality of life. Addressing this issue requires a comprehensive approach involving cooperation between governments, businesses and society to achieve shared goals. This study evaluates the interaction between energy-saving technologies and the digital economy in green business and offers practical recommendations for entrepreneurs and government agencies to support green businesses through political and economic measures. Research employed methods such as literature review, monographic, analytical, graphical, content analysis, comparison, synthesis and analysis, and generalisation. The article highlights the leading positions of scholars from different countries on the issues under study in recent years. A comparative analysis of the Top 10 countries of the world based on the 2023 Human Development Index and the Innovation Development Index is presented. This study shows that trends in global investment in energy efficiency (2015-2022), the growth of gross value added in the environmental goods and services sector in the EU-27 (2001-2021), and the growth of green bonds (2019-2022) within the EU-27 demonstrate the effectiveness of green entrepreneurship through innovation and digitalisation. Leading digital platforms for transferring innovations to green businesses were identified. The article also provides practical recommendations for the transfer of innovations to promote green business development in the context of digital transformation for entrepreneurs and government agencies.

Keywords

Green entrepreneurship; Energy-saving technologies; Green economy; Innovation; Digital economy

Introduction

Climate change, environmental pollution and depletion of natural resources necessitate finding new solutions to reduce the negative impact on the environment. Climate change has become one of the most critical and hotly debated issues of the twenty-first century, threatening to destroy the world. One of the main causes of climate change is greenhouse gas emissions, which are wreaking havoc on the earth (Shang *et al.*, 2022). Energy-saving technologies and digital innovations can significantly reduce greenhouse gas emissions and resource consumption. Society, investors, and consumers increasingly demand that businesses adhere to the principles of sustainable development. Green businesses that integrate energy-saving technologies with the digital economy meet these requirements and create competitive advantages (Zhu *et al.*, 2023). The development of digital technologies, such as the Internet of Things (IoT), artificial intelligence, blockchain, and big data, opens up new opportunities for optimizing business processes and improving energy efficiency (Kalla *et al.*, 2024). Integrating these technologies into green businesses can significantly increase their efficiency and sustainability. Using energy-saving technologies and digital solutions can reduce energy and resource costs, increase productivity and reduce operating expenses. This helps enhance profitability and create new economic opportunities.

Many countries are adopting policies and international agreements to support green entrepreneurship and reduce greenhouse gas emissions (OECD, 2022). Research into innovative approaches can help develop effective policies and strategies to implement these commitments. Traditional business models often do not meet the requirements of modern challenges (Hina *et al*., 2022). Innovative approaches to green entrepreneurship which integrate energy-saving technologies and the digital economy contribute to creating new, more sustainable business models. Green entrepreneurship supports job creation, improves the quality of life, and preserves environmental balance (INNO GREEN, 2018). This is especially important in sustainable development and preservation of natural resources for future generations. The combination of green technologies and the digital economy opens up new opportunities for innovation, the development of new markets, and investment. This helps to reduce and alleviate the environmental burden, optimize resources, and increase energy stability. However, the strategy requires significant investment, the development of digital skills, and government support. Overall, this approach has great potential for Ukraine's sustainable development but requires a comprehensive approach with innovation, investment, and training.

The purpose of this study is to assess the interaction of energy-saving technologies and the digital economy in the context of green entrepreneurship development and offer practical recommendations for entrepreneurs to implement innovative approaches, as well as for government agencies to support green entrepreneurship through political and economic measures. The following research objectives were set to guide this study: 1) to perform a literature review of the problems of forming green entrepreneurship in the context of digitalization to ensure sustainable development; 2) to identify trends in global energy efficiency investments; 3) to analyse the impact of green business on the sustainability of economic development and value-added; 4) to identify the practical recommendations for the transfer of innovations to ensure the development of green business in the context of digital transformation.

Literature Review

Sustainable development is the central paradigm of future social development, and developing a circular economy through globalisation and digitalisation will contribute to achieving these goals. The study's practical significance is to deepen the theory and practice of circular economy development Sustainable development is the central paradigm of future social development, and the development of the circular economy through globalization and digitalization will contribute to achieving these goals. The practical significance of the study (Gavkalova *et al.*, 2024) is to deepen the theory and practice of circular economy development. The depletion of natural resources poses threats to industrial development, provision of material goods, and quality of life. The authors believe that irrational use of natural resources and inefficient resource management worsen the environmental situation and reduce the efficiency of enterprises. The analysis shows that sustainable development has become a key paradigm of the future, and the development of the circular economy is one of the mechanisms for achieving this goal through its links to globalization, digitalization, innovation, and digital distribution. The findings contribute to the development of the theory and practice of the circular economy.

Globalisation challenges and threats highlight the need for countries to strengthen financial security through systemic measures and adaptation of strategies to new economic realities. The need to integrate digital technologies into the financial and economic sectors is emphasised significantly by Desyatnyuk (2024), who also presents the principal elements and tools of entrepreneurial innovation systems that allow the commercialisation of scientific projects and research. The practical significance lies in the fact that the proposed model of interaction between businesses, the state, and universities is an effective mechanism for solving the issue of forming a system of entrepreneurial innovation initiatives (Krysovatyy and Ptashchenko, 2023). Semenenko (2016) shows the connection between energy sources and energy security with sustainable development, reveals the dependence on energy security, and indicates its main threats and ways out, as shown in the example of Ukraine. A new typology of business models for green technologies is proposed, illustrated by various environmental technological solutions (Trapp and Kanbach, 2021). Scientists believe environmental responsibility is essential to regulate at the national, regional and corporate levels (Bobkova *et al.*, 2021). It has been determined that green entrepreneurship is essential for creating new business opportunities in the circular economy, sustainable development, and overcoming the socio-economic and environmental challenges humanity faces (Mondal, Singh and Gupta, 2023a).

Challenges in the study of green entrepreneurship include the development of adequate definitions, the choice between qualitative and quantitative approaches, and the fact that most studies focus on existing businesses, leaving out new and disappeared businesses (Schaper, 2016). As the digital economy has developed, its impact on green innovation and energy efficiency has become a current research focus. Results show that running a business based on green technologies or positioning it in the green sector does not significantly impact the likelihood of receiving venture capital. However, it can serve as a reliable signal for investors (Mrkajic, Murtinu and Scalera, 2017). To fully utilise the potential of promoting energy efficiency, the sustainability of the green innovation system

needs to be strengthened. A policy focus on "digital greening-energy efficiency" should support the development of the digital economy (Shevchenko *et al.,* 2023). The rational allocation of resources and the implementation of green standards should be strengthened during the development of the digital economy, and the constraints that hinder energy efficiency in the early stage of digitalisation should be overcome by accelerating the digitalisation process (Ma and Lin, 2023; Wu, Zhu and Wang, 2024). Econometric studies of entrepreneurship show that the environmental orientation of new businesses is a critical factor for sustainable development (Neumann, 2022). Currently, more and more attention is being paid to teaching students about green entrepreneurship and their interest in implementing business ideas in green entrepreneurship (Alekseieva *et al*., 2023).

It has been concluded that concern for green entrepreneurship among students positively correlates with entrepreneurial education and environmental knowledge (Anghel and Anghel, 2022). The impact of intellectual capital on supply chain circular economy (SCCE) systems, consisting of a closed supply chain (CLSC) and a reverse omni-channel, is studied (Zheng *et al.*, 2024). Evidence of the impact of the digital economy on carbon emissions at the household level has been analysed, which helps to understand the interaction between production and consumption in achieving carbon neutrality and identify ways to reduce emissions from consumption (Du, 2024). It has been proven that digital transformation should be considered not only in the context of business models but also in terms of economic effects and their feasibility (Gorokhova, 2021), with state audits playing a crucial role in improving energy efficiency and promoting green and low-carbon economic development (Liu, Nie and Lin, 2024).

There are different views on the role of the digital economy in green entrepreneurship. Some researchers believe that energy efficiency and natural resources contribute to reducing the ecological footprint (Sotnyk *et al*., 2023). The digital economy has a detrimental effect on reducing the ecological footprint with the development of renewable energy (Zhao, Lin and Bashir, 2024), noting that the actual impact of the digital economy on sustainable development can be more accurately determined through better construction of the digital economy index (Huang and Lin, 2024). Other studies have shown that improving digital infrastructure significantly improves industrial energy efficiency (Wang and Shao, 2024; Li and Gao, 2024), and digital technologies have become a promising measure to improve energy efficiency and reduce emissions (Zhang, Liu and Fu, 2024).

Therefore, this study is relevant for entrepreneurs, policymakers, researchers and society as a whole, as it contributes to developing effective strategies to support green entrepreneurship and the transition to a more sustainable economy in the context of digitalisation.

Research Methods

The authors proposed a comprehensive approach, which includes researching consumer needs, searching for technological solutions through patent research, evaluating engineering solutions considering technical, operational and market parameters, cost estimation and selection of an engineering innovation following Khaminich *et al*. (2020).

Synthesis, Analysis and Literature Review:

The method of synthesis and analysis was used for the identification of the most effective digital platforms for transferring innovations to green businesses following Barton *et al.* (2007). This method involves combining various pieces of information to form a cohesive understanding and breaking down complex information into smaller components for detailed examination. By synthesizing and analyzing data from the analyzed literature, the study identified the key platforms that facilitate the transfer of innovative technologies and practices to green businesses, highlighting their roles and effectiveness in promoting sustainable development. The following keywords were used to compile a list of reviewed literature on the subject matter under study: "Green entrepreneurship strategies", "Sustainable energy technologies and digital economy", "Integration of renewable energy with digital transformation", "Green economy and innovation in digital platforms", "Circular economy and digitalization in the energy sector". The following search and combined queries were also used: "Sustainable business models in green technology and digital economy", 'Impact of digitalization on green energy solutions', 'Green entrepreneurship and IoT/blockchain in the energy sector'. Appropriate filters were applied, in particular: subject matter (environmental technologies, digitalization of the economy, innovations in the energy sector); chronology (publications mainly for 2018-2024 to obtain the most relevant research); type of sources (scientific journals, peer-reviewed articles, reports of international organizations (OECD, IRENA, EU); databases (Google Scholar, Scopus, Web of Science, SSRN were used). The literature review included sources that present new approaches or analysis of current cases, reports based on verified empirical data, publications with a clear methodology and evidence base, articles analyzing successful cases of integration of environmental and digital solutions, and sources that highlight the relationship between innovation, globalization, and the green economy. The final sample included sources that provide a holistic understanding of the topic and highlight the latest developments in green entrepreneurship and the digital economy.

Monographic Analysis:

The use of the monographic method helped to highlight the trends in global investment in energy efficiency over 8 years (2015-2022), and gross value added in the environmental goods sector in the EU over 20 years (2001-2021). The monographic method is one of the qualitative methods that involves an in-depth study of a single object or phenomenon, using detailed analysis to identify its characteristics and relationships (Lisboa, 2015). It is particularly effective as a study of a unique phenomenon - the development of green business - allowing for a comprehensive description and analysis of current trends.

Content Analysis:

We used the content analysis method to elucidate the challenges inherent to the green economy. This method is based on a quantitative and qualitative analysis of the content of information sources, which allows us to study how green entrepreneurship ideas are reflected in various media, publications, regulations, and business practices. We

examined a range of media materials and statistical data from authoritative sources, including EUROSTAT, UNSD, and GMI (UNSD, 2024).

Generalization:

Practical recommendations for implementing innovative developments, the generalisation method was used, to ensure the development of green business in the context of digital transformation and the study's general conclusion, following Ahtisham *et al.* (2023). This method, due to its versatility, helped to take into account both global trends and local specifics, to systematize innovations into an economic model that meets the challenges of digital transformation and promotes sustainable development.

These methods allowed for a comprehensive study of innovative approaches to green entrepreneurship, identification of effective digitalisation platforms and development of recommendations for their implementation.

Results

Current state of green entrepreneurship and the digital economy

Today, humanity faces three significant challenges: environmental change, severe pollution and the availability of energy resources. The decline in the use of fossil fuels and sudden changes in the environment are forcing us to think about a challenging future. This challenge requires modifications to energy infrastructure and the application of environmentally friendly methods. There is a great need for renewable, biodegradable, and environmentally friendly products and services. The transition from fossil fuels to solar, tidal, and geothermal energy is urgently needed, and not only awareness but also the practical application of these technologies is essential, as highlighted by Sakhrekar and Sayankar (2023). Therefore, in recent years, green entrepreneurship has become one of the most critical factors in achieving competitive advantage and business sustainability.

Today's businesses are becoming increasingly conscious and responsible for contributing to the environment. A green initiative in business is now considered an indicator of social responsibility and a strategic step towards sustainable development. One of the critical aspects of this initiative is efficient energy supply (Ye *et al.*, 2023). It is crucial to compare the correlation between the Human Development Index, one of the indicators of sustainable development of the country's economy, and the Innovation Development Index among the leading countries in 2023 (see Figure 1).

The data show that the HDI is consistent with the GII, i.e., the well-being of humanity and the development of society directly depend on the introduction of innovative technologies. Based on the data from UNDP (2024), we will determine the relationship between HDI and GII on the example of two countries (Table 1).

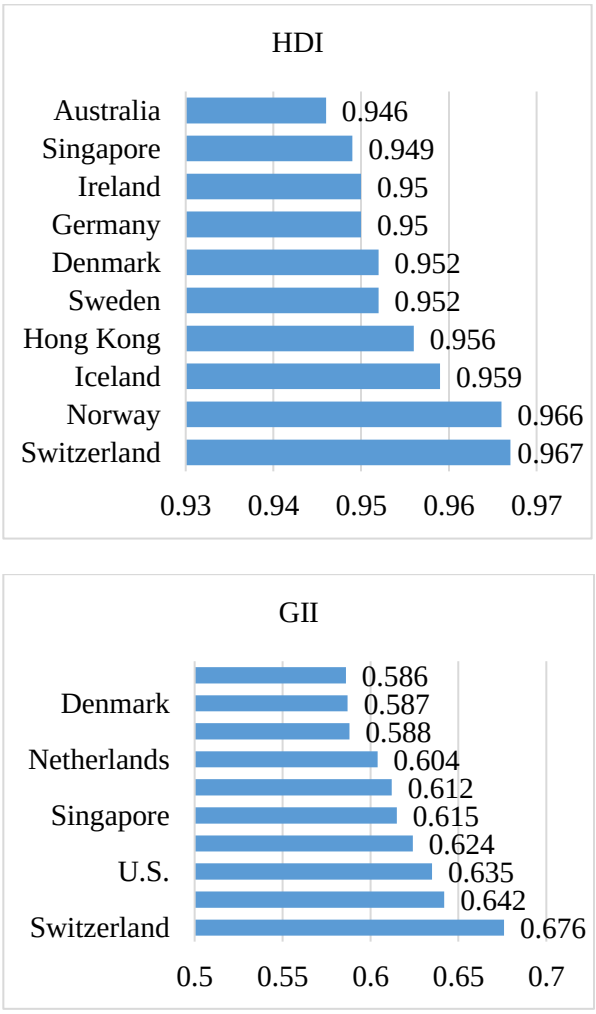

Figure 1: Top 10 countries in the World according to the Human Development Index (HDI) and the Global Innovation Index (GII) 2023 (Conte, 2023; HDI, 2023)

Table 1: Correlation analysis of HDI and GII dependence, (2016-2024)

Parameter	*Ukraine*		*Sweden*	
	GII	*HDI*	*GII*	*HDI*
GII	1		1	
HDI	0.9283	1	0.2940	1

The analysis of the data shows that in a country with a high level of economic development, the correlation coefficient is 0.294 (Sweden), and 0.928 in a developing country (Ukraine). Thus, the global human development index and the innovation index were significantly consistent and highly correlated for the countries studied in 2016-2024.

Global investments in energy efficiency

The scientific community believes that in order to ensure sustainable development, it is necessary to divide the development of production processes focused on digitalization and innovation in the economy into stages of standardization, adaptability, and predictability (Sánchez-García *et al.,* 2023). This will ensure a consistent digital transformation that will open up fundamentally new opportunities for creating added value in almost all sectors of the economy (Kraus *et al.*, 2023). Trends in global energy efficiency investments in 2015–2022 are positive (see Table 1).

Table 2: Trends in Global Energy Efficiency Investments, 2015–2022, USD billion

Years	*Industry*		*Buildings*		*Transport*	
	Energy efficiency	*Electrification and end-use*	*Energy efficiency*	*Electrification and end-use*	*Energy efficiency*	*Electrification and end-use*
2015	21	18	147	76	96	0
2016	22	18	162	73	112	1
2017	22	18	164	76	95	5
2018	22	19	149	92	94	13
2019	21	18	163	83	105	19
2020	21	17	184	78	55	27
2021	23	19	211	82	95	55
2022	24	20	215	84	128	93
Growth, %	14.3	11.1	46.3	10.5	33.3	*

Source: IEA (2023)

The main driver of this growth has been the active adoption of electric vehicles (EVs) and the development of charging station infrastructure, which is driving the market. Innovations in battery technologies, government incentive programs (e.g., tax breaks), and efforts by automotive companies to increase the range of EV models available to a wide range of consumers also have a significant impact. For example, between 2021 and 2022, the number of available heavy electric vehicle models increased by almost 87%, and the range for passenger cars is projected to expand to 197 models by the end of 2025. This demonstrates the active implementation of electrification at all levels of transportation, which helps reduce dependence on fossil fuels and reduce CO_2 emissions (Pulido-Sánchez *et al.,* 2022). Experts believe these trends will contribute to the development of offshore and onshore projects and the growing popularity of clean fuel alternatives. By 2030, revenues from wind farms are expected to exceed USD 20 billion. The advancement of electrolyzer projects and new policy initiatives will help to make more efficient use of wind energy for clean hydrogen production (GMI, 2024). In 2022, Nova Scotia became the first province in Canada with an industrial wind farm off the coast and plans to add 5 GW of capacity by the end of the decade to support the production of clean hydrogen (GMI, 2024).

Efficient energy supply, including renewable energy sources, significantly reduces greenhouse gas and pollutant emissions. This helps preserve ecosystems and improve the quality of air, water and soil quality. Businesses can reduce their energy costs by

using energy-saving technologies and optimising energy consumption. While the initial investment may be high, the long-term savings in operating costs make it worthwhile. Eurostat data for 2001-2021 show that gross value added in the environmental goods and services sector has increased. This indicates the growing importance of this sector in the economy, as the growing demand for environmentally friendly technologies and services stimulates innovation and investment. The expansion of this sector contributes to the transition to a more sustainable economy by reducing environmental impact and creating new jobs in the field of green technologies (see Figure 2).

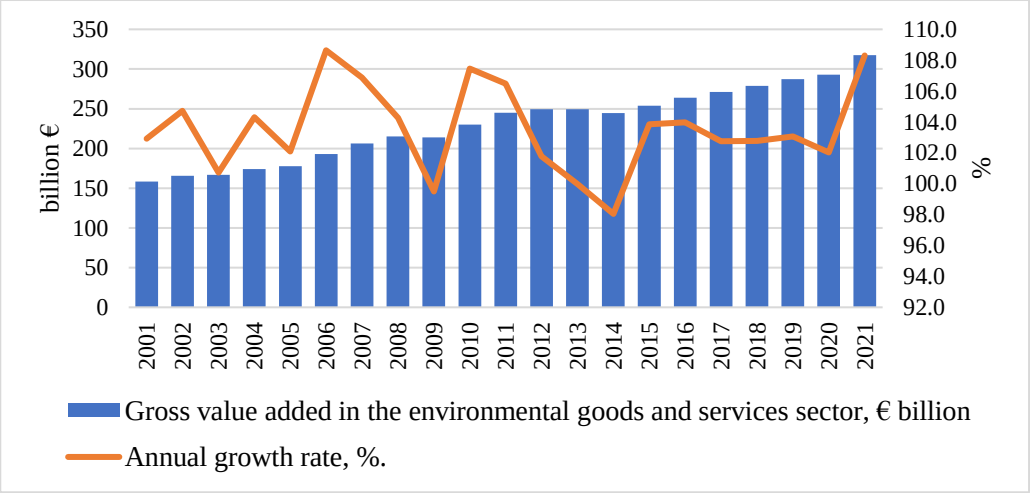

Figure 2: Gross Value Added in the Sector of Environmental Goods and Services (27 EU countries), EUR billion (Eurostat, 2024a)

Data shows that the demand for green lifestyles is growing sharply as people feel the effects of the climate crisis, which calls for the development of green entrepreneurship. Businesses that implement green initiatives can gain a competitive advantage. Consumers and partners increasingly value environmental responsibility, which can increase customer loyalty and attract new partners and investors.

Efficient energy supply is at the heart of a business's green initiative. It not only helps to preserve the environment but also provides economic benefits, increases competitiveness, stimulates innovation, meets regulatory requirements and strengthens the company's social responsibility. Investing in renewable energy sources and energy-saving technologies is essential for sustainable business development and ensuring its long-term success. According to the approximation equation, the share of renewable energy in gross final energy consumption by sector for 2004–2022 has a linear trend with a value of 98.8% ($R^2 = 0.9877$) for 27 EU countries (see Figure 3).

Green business, focused on reducing negative environmental impact and promoting sustainable development, requires transformational changes in business processes. These changes include adapting to environmental standards, using innovative technologies and increasing resource efficiency (Bielialov *et al*., 2023).

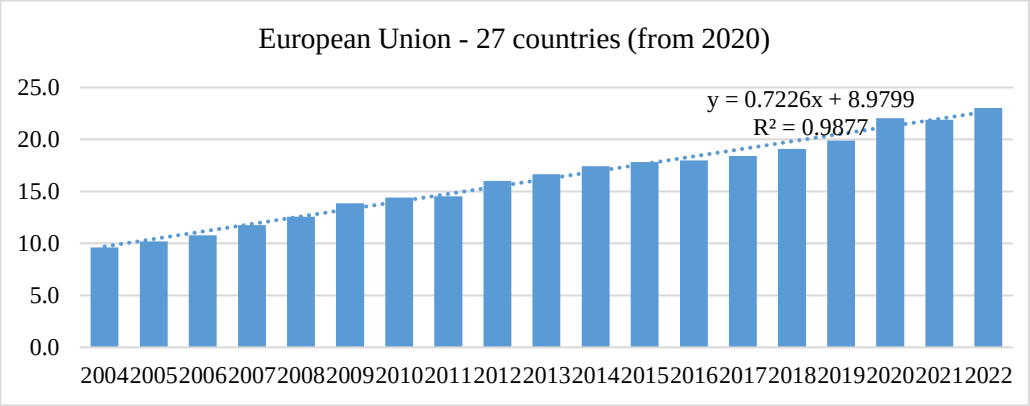

Figure 3: Ratio of Renewable Energy Sources in Gross Final Energy Consumption by Sector (27 EU)] (Eurostat, 2024b)

Green bonds are instruments designed to raise funds for environmentally friendly and sustainable development projects (Sharma and Kautish, 2023). They are issued by governments, financial institutions, or private companies and aim to finance initiatives that positively impact the environment. The general government debt issued as green bonds in 27 EU countries increased more than threefold between 2019 and 2022 (see Figure 4).

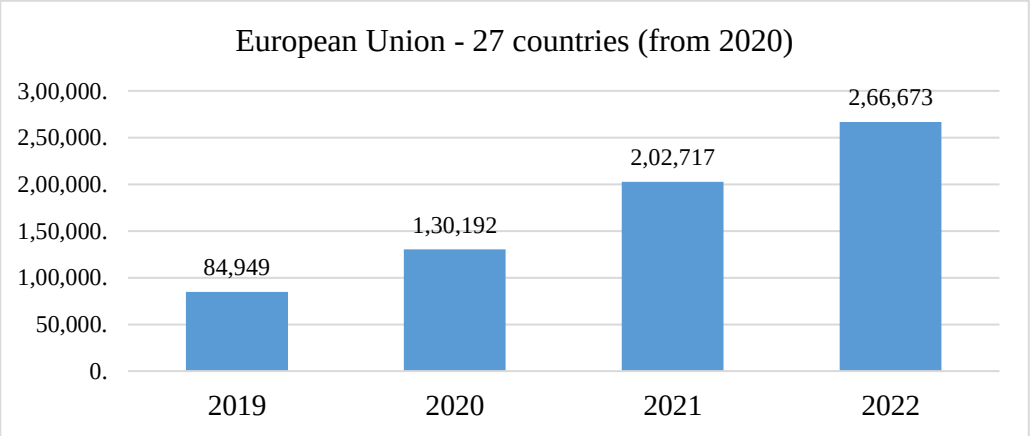

Figure 4: Amount of Public Borrowing through Green Bonds (27-EU), EUR million (Eurostat, 2023)

The growing popularity of green bonds demonstrates the commitment of EU countries to support sustainable development and environmental initiatives. This indicates that governments and the private sector are actively investing in projects that help reduce carbon emissions and protect the environment. Overall, the growth of the green bond market in the EU is a positive indicator of environmental responsibility, economic innovation and political will to support sustainable development.

Digital platforms for green business

Digitalization plays a key role in the development of green business. The integration of energy-saving technologies and the digital economy into green businesses provides economic benefits and contributes to sustainable development and environmental improvement. According to the World Economic Forum's Fostering Effective Energy Transition 2023 report, the global energy transition has stalled after a decade of progress due to the global energy crisis and geopolitical instability (WEF, 2023). The Energy Transition Index, which compares 120 countries on the efficiency of their energy systems and readiness for further change, shows that despite significant achievements in clean and sustainable energy, new challenges are emerging related to energy equity, access to energy at affordable prices, and sustainable economic development. This is due to the fact that many countries have shifted their focus to energy security. It is important to pay attention to the leading digital platforms that facilitate the exchange of knowledge and resources between green businesses and the introduction of energy-saving technologies that support sustainable development and environmental efficiency (see Figure 5).

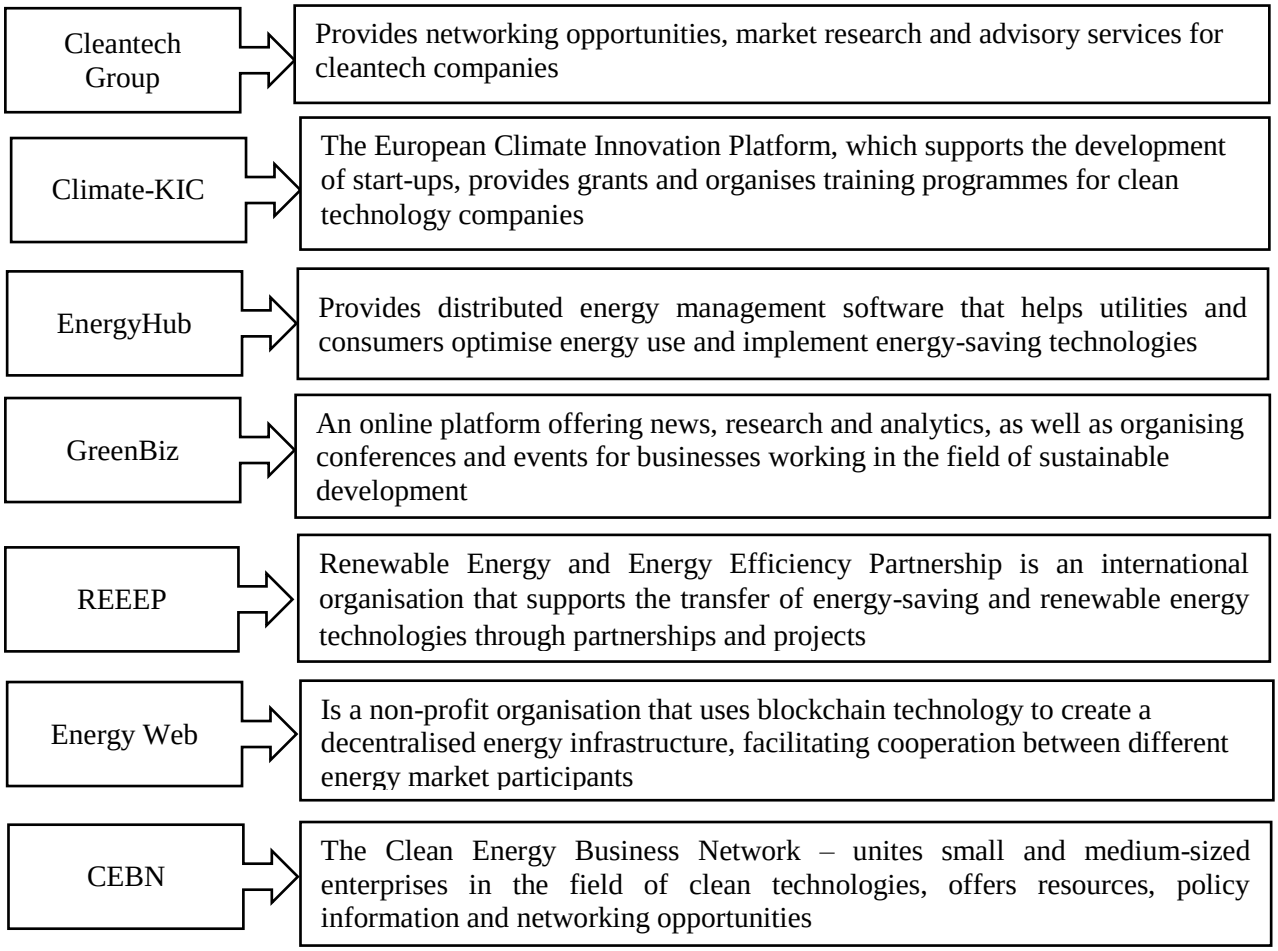

Figure 5: Digital Platforms for Transferring Innovations to Green Business (Ning, Jiang and Luo, 2023)

These platforms foster business cooperation, support innovation, and help implement energy-saving technologies contributing to a green economy. Integrating digital technologies with energy-saving systems creates smart grids that increase the efficiency and reliability of energy supply, and digital tools provide continuous feedback that allows energy-saving technologies to be quickly adapted to changing conditions.

Discussion

The implementation of green business initiatives faces a number of constraints in regions or industries with fewer resources. The main problems identified in the research include: financial barriers, institutional and regulatory gaps, insufficient infrastructure, and human capital development. The study identified the main gaps and the need for further work. Many studies have focused on developed countries, while in developing countries, the analysis of the impact of green initiatives remains insufficiently studied. That is, there are conflicting views in the literature on the profitability of green entrepreneurship, especially in sectors that traditionally depend on fossil fuels (Söderholm, 2020; Tekala *et al.*, 2024). Although digitalization has significant potential to promote green entrepreneurship, the issue of integrating green technologies with digital solutions requires deeper analysis. In our opinion, further research is needed to overcome these challenges, including: developing affordable financial mechanisms for SMEs; studying the impact of digitalization on stimulating green entrepreneurship in resource-limited settings; and developing training and knowledge dissemination strategies in less developed regions.

Mitigating climate change's effects is a critical issue on the global political agenda. Many governments and local authorities have committed to ambitious targets to transition to a greener and more sustainable economy. Around 200 countries have signed the Paris Agreement, committing to keep the rise in global average temperature to well below 2 degrees Celsius above pre-industrial levels, with many planning to achieve zero greenhouse gas emissions by 2050 (UN, 2015). This requires rapid innovation, investment in new technologies, and implementing policies that change the behaviour of individuals and companies. The COVID-19 pandemic enabled governments to accelerate this process by leveraging economic incentives that can support environmental measures. The war in Ukraine and rising energy prices have highlighted the need to find new, reliable energy sources. Green businesses are anticipated to open up new markets for entrepreneurs and serve as key drivers of global change. Government agencies play a crucial role in stimulating and supporting green entrepreneurship by creating favourable conditions, providing financial assistance, developing infrastructure, and supporting innovation and collaboration (see Table 3).

Governments can bridge the digital and green divide by implementing the following strategies: financial incentives for innovation, investment in the Internet and green energy, creation of innovation clusters, training programs to develop digital and environmental skills, support for start-ups through incubators, public-private partnerships, technology grants, and removal of bureaucratic barriers. Other measures include developing energy autonomy through renewable energy sources, providing access to high-speed Internet, and using big data to identify regions in need of support. Policy should be based on analysing the socioeconomic context of the regions. Priority

should be given to areas that have the potential to quickly integrate innovations, which will provide a multiplier effect for other areas. Such strategies not only reduce regional gaps but also stimulate the development of sustainable and inclusive economic growth.

Table 3: Practical Recommendations on Innovation Transfer to Ensure the Development of Green Business in Digital Transformation

Focus	*Practical activities*
For entrepreneurs	
Integration of digital technologies	Using IoT to monitor and manage energy and resource consumption and automated systems to optimise production processes and reduce waste
Development and implementation of environmentally friendly products	Implementing eco-design principles to create easily recyclable or reusable products and environmental certificates to confirm that products meet environmental standards.
Digital platforms and marketing	Active use of social media to promote its products and raise consumer awareness of environmental benefits, expanding the range of online sales in digital marketplaces to increase market coverage.
Partnerships and collaborations	Forming diversified networks of green entrepreneurs to share experiences and jointly solve problems and innovation hubs.
Financing and investment	Use crowdfunding platforms, grants and subsidies to attract funding from environmentally conscious investors to implement green technologies.
For government agencies	
Policy measures	Legislative support (tax benefits, subsidies) to stimulate the development of green entrepreneurship and establish and update environmental standards for products and processes in line with modern requirements.
Economic measures	Targeted subsidies and grants will support research, the transfer of innovations in green business, and the introduction of preferential lending programmes for small and medium-sized enterprises engaged in environmentally friendly projects.
Education and outreach	Developing training programmes and courses to improve entrepreneurs' skills in green technologies and digitalisation, conducting information campaigns to raise awareness of the importance of green entrepreneurship among the public and entrepreneurs.
Infrastructure support	The creation of innovation hubs and clusters will facilitate cooperation between entrepreneurs, researchers, and government agencies and the development of renewable energy infrastructure.
Monitoring and evaluation	Establishing a system for monitoring and evaluating the effectiveness of green technologies and support programmes, creating a database, and analysing the development of green businesses to improve policies and programmes to continuously support them.

Source: Based on analyzed literature (GWI, 2023; NYU STERN, 2024; OECD, 2022; SA, 2024; Sharma and Kautish, 2023)

The first main conclusion about the integration of digital technologies into green entrepreneurship is confirmed by researchers from around the world (Fernandes, Pires and Alves, 2022; Mondal, Singh and Gupta, 2023b; Wang *et al.*, 2024; Xu, Zhang and Wang, 2024). Some studies clarify the determinants of corporate green innovations, identify key factors that influence their implementation, and provide important information for making strategic decisions to improve the environmental responsibility of businesses. In addition, the study sheds light on the relationship between green initiatives and digital tools, emphasizing the importance of synergy between these areas for the sustainable development of companies. This contributes not only to improving environmental efficiency but also to creating long-term value for all stakeholders in the process of corporate digital transformation (Li and Shen, 2021; She and Zhang, 2024; Zhu, Huang and Koompai, 2024). In 2024, the "Call for Proposals for Digital and Green Innovation in Africa" was announced among African countries (D4D Hub, 2024).

The second main conclusion is the socio-economic development of society and the greening of production. Shamsuzzoha *et al*. (2023) emphasize the need to build environmental security, and offer a new theoretical justification for the links, taking into account the mediating problems of green innovation strategies, including the lack of government support, lack of resources and skilled labour. It is believed that future research should cover more regions and countries and take into account economic and cultural aspects, especially in newly industrialized countries. For future research on green business development, it is important to extend the analysis to more regions and countries to provide a more complete understanding of global trends. In particular, taking into account economic and cultural aspects can ensure the relevance of findings for newly industrialized countries (NICs), such as India, Brazil, or Indonesia, where green business development faces economic challenges such as the impact of different income levels of on the adoption of green innovations; limited access to investment and credit for small and medium-sized businesses; and uncertainty about the long-term profitability of environmental projects. Cultural aspects include: local habits and traditions that influence the consumption of environmentally friendly products and services; perception of risks and benefits associated with the green economy; and the level of awareness of environmental issues.

Research by scientists from the Baltics emphasizes the ability of green startups to solve environmental problems and influence economies and communities. An important role of green entrepreneurs is to use creative thinking and progressive connections to promote positive change. Further environmental initiatives are needed to have a greater impact on the transition to a sustainable society (Prokopenko *et al*., 2024). At the same time, human capital is a factor in our global growth, prosperity and progress. The meaning and role of this little word, green, are so significant that our lives and future depend on it (AlQershi *et al*., 2023). Therefore, practical recommendations for entrepreneurs on implementing innovative approaches in green business development and digitalisation are needed: increasing competitiveness, optimising resources, reducing environmental impact, meeting regulatory requirements, stimulating investment, supporting sustainable development, and ensuring digital transformation. The implementation of SDG 7 creates a framework for the sustainable development of green business, promotes investment and innovation in this area, and integrates environmental principles into economic activity (UNDP, 2015). As a result of the conducted research, it has been established

that: digital tools, such as automation and analytics systems, allow for more precise control and optimisation of energy consumption, which reduces costs and improves efficiency; data analysis tools enable the forecasting of energy needs and the planning of purchases, which helps to lower energy resource costs; the implementation of energy-saving technologies and the use of renewable energy sources reduce greenhouse gas emissions and improve the environmental footprint of enterprises; companies that use energy-efficient and environmentally friendly technologies can obtain green certificates, enhancing their image and competitiveness; integrating modern technologies enhances enterprise innovation and increase their appeal to both investors and consumers. Additionally, green initiatives and energy-efficient technologies strengthen a company's reputation as a responsible and sustainable business; the use of energy-saving technologies supports compliance with national and international environmental initiatives and programmes; digitalisation helps to reduce waste and conserve resources through more accurate control and management. Integrating innovations, energy-saving technologies, and the digital economy creates a synergy that contributes to achieving more significant results. Thus, implementing such measures is an investment in the future of entrepreneurship, ensuring long-term sustainability and the development of the national and global economy.

Conclusion

This study aimed to explore the impact of digital transformation on green business development, identifying critical recommendations for entrepreneurs and policymakers. The findings reveal that integrating IoT, eco-design, and digital marketing significantly enhances sustainability and economic viability. These recommendations provide a roadmap for transitioning to a greener economy while addressing global challenges such as climate change, resource scarcity, and economic inequality. The correlation analysis between the Human Development Index (HDI) and the Global Innovation Index (GII) demonstrates that well-being and societal development are closely linked to the adoption of innovative technologies. The significant correlation found between HDI and GII in countries with varying levels of economic development emphasizes the importance of innovation in achieving sustainable development goals. The expansion of the environmental goods and services sector and the increase in gross value added reflect the growing importance of green technologies and services in the economy. Businesses that implement energy-saving technologies and optimize energy consumption are not only contributing to environmental preservation but also gaining competitive advantages, economic benefits, and increased social responsibility. The growth of the green bond market in the EU signifies strong commitments from both governments and the private sector towards sustainable development. This trend is indicative of a broader movement towards environmental responsibility and economic innovation, supported by political will and financial investments. Digitalization is identified as a key enabler in the development of green businesses, facilitating the integration of energy-saving technologies and enhancing overall efficiency. The role of digital platforms in fostering business cooperation and innovation is crucial for the continued progress towards a green economy. The main recommendations for government agencies include legislative support, subsidies and grants, soft loan programs, training courses, innovation hubs, and monitoring the effectiveness of green technology implementation. For future research directions, it is important to focus on the following issues: comparing the effectiveness

of government policies to stimulate green entrepreneurship in different regions; studying the role of transnational companies in promoting green business through supply chains; analyzing economic incentives for attracting investments in green business in developing countries; studying social innovations and their contribution to the development of environmentally friendly enterprises. These studies will help create a more holistic picture of the development of the green economy and contribute to the formation of universal approaches to integrating environmental initiatives in different economic and cultural contexts.

References

Alekseieva, K., Maletych, M., Ptashchenko, O., Baranova, O. and Buryk, Z. (2023). State business support programs in wartime conditions. *Economic Affairs*, 68(1): 231–242. DOI: https://doi.org/10.46852/0424-2513.1s.2023.26

AlQershi, N.A., Saufi, R.B.A., Yaziz, M.F.B.A., Ramayah, T., Muhammad, N.M.N. and Yusoff, M.N.H.B. (2023). The relationship between green entrepreneurship, human capital and business sustainability in Malaysian large manufacturing firms: An empirical study. *Technological Forecasting and Social Change*, 192: 122529. DOI: https://doi.org/10.1016/j.techfore.2023.122529

Anghel, G.A. and Anghel, M.A. (2022). Green Entrepreneurship among Students-Social and Behavioural Motivation. *Sustainability*, 14(14): 8730. DOI: https://doi.org/10.3390/su14148730

Barton, J. and Haslett, T. (2007). Analysis, synthesis, systems thinking and the scientific method: Rediscovering the importance of open systems. *Systems Research and Behavioral Science*. DOI: https://doi.org/10.1002/sres.816

Bielialov, T., Kalina, I., Goi, V., Kravchenko, O. and Shyshpanova, N. (2023). Global experience of digitalization of economic processes in the context of transformation. *Journal of Law and Sustainable Development*, 11(3): e0814. DOI: https://doi.org/10.55908/sdgs.v11i3.814

Bobkova, A., Andryeyeva, N., Verbivska, L., Kozlovtseva, V. and Velychko, V. (2021). Environmental Responsibility In The Development Of Green Entrepreneurship. *Studies of Applied Economics*, 38(4). DOI: https://doi.org/10.25115/eea.v38i4.4003

Conte, N. (2023). Ranked: The Most Innovative Countries in 2023. Available online at: https://www.visualcapitalist.com/most-innovative-countries-in-2023/ [Accessed on 12 August 2024]

D4D Hub (2024) Call for proposals on digital and green innovations in Africa. *Join the Digital for Development (D4D) Hub*. https://shorturl.at/pVUSd

Desyatnyuk, O. (2024). Financial Security in the Conditions of Globalisation: Strategies and Mechanisms for the Protection of National Interests. *Economic Affairs*, 69(1): 261–268. DOI: https://doi.org/10.46852/0424-2513.1.2024.27

Du, Z., Xu, J. and Lin, B. (2024). What does the digital economy bring to household carbon emissions? – From the perspective of energy intensity. *Applied Energy*, 370: 123613. DOI: https://doi.org/10.1016/j.apenergy.2024.123613

Eurostat (2023). Stock of general government debt security liabilities issued as 'green bonds' – one-off data collection, experimental statistics. Available online at: https://ec.europa.eu/eurostat/databrowser/view/gov_gb/default/table?lang=en [Accessed on 12 August 2024]

Eurostat (2024a). Gross value added in environmental goods and services sector. Available online at: https://shorturl.at/ND2uB [Accessed on 12 August 2024]

Eurostat (2024b). Share of renewable energy in gross final energy consumption by sector. Available online at: https://shorturl.at/IHVsQ [Accessed on 12 August 2024]

Fernandes, C., Pires, R. and G. Alves, M.C. (2022). Digital Entrepreneurship and Sustainability: The State of the Art and Research Agenda. Economies, 11(1), 3. DOI: https://doi.org/10.3390/economies11010003

Gavkalova, N., Martin, J., Shumska, H. and Babenko, K. (2024). Landscape and circular economy as a mechanism of sustainable development in globalisation and digitalisation of the world economy. *Development Economics,* 23(2): 80–90. DOI: https://doi.org/10.57111/econ/2.2024.80

GMI (2024). Green Hydrogen Market Size, Forecast Report, 2024–2032. Global Market Insights Inc. Available online at: https://www.gminsights.com/industry-analysis/green-hydrogen-market/market-analysis [Accessed on 12 August 2024]

Gorokhova, T. (2021). The transformation of business processes in the conditions of digitalisation of economic systems. *Economic journal of Lesya Ukrainka Volyn National University*, 3(27): 14–21. DOI: https://doi.org/10.29038/2786-4618-2021-03-14-21

GWI (2023). Health, Happiness, and the Wellness Economy: An Empirical Analysis Global Wellness Institute. Available online at: https://ln.run/7iaEk [Accessed on 12 August 2024]

HDI (2023). Human Development Reports. Available online at: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI [Accessed on 12 August 2024]

Hina, M., Chauhan, C., Kaur, P., Kraus, S., and Dhir, A. (2022). Drivers and barriers of circular economy business models: Where we are now, and where we are heading. *Journal of Cleaner Production*, 333, 130049. DOI: https://doi.org/10.1016/j.jclepro.2021.130049

Huang, C. and Lin, B. (2024). How digital economy index selection and model uncertainty will affect energy green transition. *Energy Economics*, 107774. DOI: https://doi.org/10.1016/j.eneco.2024.107774

IEA (2023). Global energy efficiency-related investment by scenario, 2015–2022. Charts – Data and Statistics. Available online at: https://shorturl.at/93gz9 [Accessed on 12 August 2024]

INNO GREEN (2018) Encouraging INNOvation for development of GREEN jobs. https://eic.ec.europa.eu/system/files/2021-06/776799_Innogreen_DOP.pdf

Kalla, D. and Smith, N. (2024). Integrating Iot, AI, And Big Data For Enhanced Operational Efficiency In Smart Factories. *Educational Administration Theory and Practices*. 30. DOI: https://doi.org/10.53555/sfs.v30i5.6492

Khaminich, S., Kuznietsov, E., Ptashchenko, O., Halaz, L., Milcheva, V. and Boiko, O. (2020). Managing the Product's Creation of an Innovation-Oriented Engineering Business. *International Journal of Advanced Research in Engineering and Technology*, 11(4): 278–289. Available online at: https://ssrn.com/abstract=3599717 [Accessed on 12 August 2024]

Kraus, K., Kraus, N., Manzhura, O., Ishchenko, I. and Radzikhovska, Y. (2023). Digital Transformation of Business Processes of Enterprises on the Way to Becoming

Industry 5.0 in the Gig Economy. *Wseas transactions on business and economics*, 20: 1008–1029. DOI: https://doi.org/10.37394/23207.2023.20.93

Krysovatyy, A. and Ptashchenko, O. (2023). The mechanism of entrepreneurial innovation system in institutions of higher education. *Economics of Development*, 22(2). DOI: https://doi.org/10.57111/econ/2.2023.51

Li, B. and Gao, Y. (2024). Impact and transmission mechanism of digital economy on agricultural energy carbon emission reduction. *International Review of Economics and Finance*, 103457. DOI: https://doi.org/10.1016/j.iref.2024.103457

Li, D., and Shen, W. (2021). Can Corporate Digitalization Promote Green Innovation? The Moderating Roles of Internal Control and Institutional Ownership. *Sustainability*, 13(24), 13983. DOI: https://doi.org/10.3390/su132413983

Lisboa, J.L.C. (2015). Use and importance of monographs. 34. 64-68. https://www.researchgate.net/publication/286035895_Use_and_importance_of_monographs

Liu, J., Nie, S. and Lin, T. (2024). Government auditing and urban energy efficiency in the context of the digital economy: Evidence from China's Auditing System reform. *Energy*, 296: 131100. DOI: https://doi.org/10.1016/j.energy.2024.131100

Ma, R. and Lin, B. (2023). Digitalisation and energy-saving and emission reduction in Chinese cities: Synergy between industrialisation and digitalisation. *Applied Energy*, 345: 121308. DOI: https://doi.org/10.1016/j.apenergy.2023.121308

Mondal, S., Singh, S. and Gupta, H. (2023a). Assessing enablers of green entrepreneurship in circular economy: An integrated approach. *Journal of Cleaner Production*, 135999. DOI: https://doi.org/10.1016/j.jclepro.2023.135999

Mondal, S., Singh, S. and Gupta, H. (2023b). Green entrepreneurship and digitalization enabling the circular economy through sustainable waste management - An exploratory study of emerging economy. *Journal of Cleaner Production*, 138433. DOI: https://doi.org/10.1016/j.jclepro.2023.138433

Mrkajic, B., Murtinu, S. and Scalera, V.G. (2017). Is green the new gold? Venture capital and green entrepreneurship. *Small Business Economics*, 52(4): 929–950. DOI: https://doi.org/10.1007/s11187-017-9943-x

Neumann, T. (2022). Impact of green entrepreneurship on sustainable development: An ex-post empirical analysis. *Journal of Cleaner Production*, 377: 134317. DOI: https://doi.org/10.1016/j.jclepro.2022.134317

Ning, J., Jiang, X. and Luo, J. (2023). The relationship between enterprise digitalisation and green innovation: A mediated moderation model. *Journal of Innovation and Knowledge*, 8(1): 100326. DOI: https://doi.org/10.1016/j.jik.2023.100326

NYU STERN (2024). Randi Kronthal-Sacco Tensie Whelan. Sustainable Market Share Index. Available online at: https://www.stern.nyu.edu/sites/default/files/2023-04/FINAL%202022%20CSB%20Report%20for%20website.pdf [Accessed on 12 August 2024]

OECD (2022a). Policies to Support Green Entrepreneurship: Building a Hub for Green Entrepreneurship in Denmark, OECD Studies on SMEs and Entrepreneurship, OECD Publishing, Paris. DOI: https://doi.org/10.1787/e92b1946-en

Prokopenko, O., Chechel, A., Koldovskiy, A. and Kldiashvili, M. (2024). Innovative Models of Green Entrepreneurship: Social Impact on Sustainable Development of Local Economies. Economics. *Ecology. Socium*, 8(1), 89–111. DOI: https://doi.org/10.61954/2616-7107/2024.8.1-8

Pulido-Sánchez, D., Capellán-Pérez, I., de Castro, C. and Frechoso, F. (2022). Material and energy requirements of transport electrification. *Energy and Environmental Science*. DOI: https://doi.org/10.1039/d2ee00802e

SA (2024). 37 Interesting sustainability facts and stats for business and CMOs. The Sustainable Agency. Available online at: https://thesustainableagency.com/blog/sustainability-facts-and-statistics-for-business-owners/ [Accessed on 12 August 2024]

Sakhrekar, S. and Sayankar, K. (2023). Green innovation and entrepreneurship. *Shodhasamhita*, 10(1): 167–175. DOI: https://doi.org/10.13140/RG.2.2.30355.25120

Sánchez-García, E., Martínez-Falcó, J., Marco-Lajara, B. and Manresa-Marhuenda, E. (2023). Revolutionizing the circular economy through new technologies: A new era of sustainable progress. *Environmental Technology and Innovation*, 103509. DOI: https://doi.org/10.1016/j.eti.2023.103509

Schaper, M. (2016). Making Ecopreneurs. Routledge. DOI: https://doi.org/10.4324/9781315593302

Semenenko, I. (2016). Energy security of Ukraine in the context of its sustainable development. *Equilibrium*, 11(3): 537. DOI: https://doi.org/10.12775/EQUIL.2016.024

Shamsuzzoha, A., Suihkonen, A.M., Wahlberg, C., Jovanovski, B. and Piya, S. (2023). Development of value proposition to promote green innovation for sustainable organizational development. *Cleaner Engineering and Technology*, 15, 100668. DOI: https://doi.org/10.1016/j.clet.2023.100668

Shang, M., Ma, Z., Su, Y., Shaheen, F., Khan, H.U.R., Tahir, L.M., Sasmoko, Anser, M.K. and Zaman, K. (2022). Understanding the importance of sustainable ecological innovation in reducing carbon emissions: investigating the green energy demand, financial development, natural resource management, industrialisation and urbanisation channels. *Economic Research-Ekonomska Istraživanja*, 1–40. DOI: https://doi.org/10.1080/1331677x.2022.2137823

Sharma, A. and Kautish, P. (2023). Measuring green finance. In Recent Developments in Green Finance, Green Growth and Carbon Neutrality (pp. 171–191). Elsevier. DOI: https://doi.org/10.1016/b978-0-443-15936-7.00008-6

She, J. and Zhang, Q. (2024). Green innovation and enterprise digital transformation: Escape from the "dilemma" of development and governance choices. *PLOS ONE*, 19(5), Article e0301266. DOI: https://doi.org/10.1371/journal.pone.0301266

Shevchenko, I., Lysak, O., Zalievska-Shyshak, A., Mazur, I., Korotun, M. and Nestor, V. (2023). Digital economy in a global context: world experience. [Economia digital em um contexto global: experiência mundial]. *International Journal of Professional Business Review*, 8(4). DOI: https://doi.org/10.26668/businessreview/2023.v8i4.1551

Söderholm, P. (2020). The green economy transition: the challenges of technological change for sustainability. *Sustainable Earth*, 3(1). DOI: https://doi.org/10.1186/s42055-020-00029-y

Sotnyk, I., Kurbatova, T., Trypolska, G., Sokhan, I. and Koshel, V. (2023). Research trends on development of energy efficiency and renewable energy in households: A bibliometric analysis 2023. *Environmental Economics*, 14(2): 13–27. DOI: https://doi.org/10.21511/ee.14(2).2023.02

Tekala, K., Baradarani, S., Alzubi, A. and Berberoğlu, A. (2024). Green Entrepreneurship for Business Sustainability: Do Environmental Dynamism and Green Structural Capital Matter? *Sustainability*, 16(13), 5291. DOI: https://doi.org/10.3390/su16135291

Trapp, C.T.C. and Kanbach, D.K. (2021). Green entrepreneurship and business models: Deriving green technology business model archetypes. *Journal of Cleaner Production*, 297: 126694. DOI: https://doi.org/10.1016/j.jclepro.2021.126694

UN (2015). Paris Agreement. 25 p. Available online at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf [Accessed on 12 August 2024]

UNDP (2015). Sustainable Development Goals. https://www.undp.org/sustainable-development-goals

UNSD (2024). The Sustainable Development Goals Report 2023: Special Edition. Available online at: https://shorturl.at/esYEy [Accessed on 12 August 2024]

Wang, B., Khan, I., Ge, C. and Naz, H. (2024). Digital transformation of enterprises promotes green technology innovation – The regulated mediation model. *Technological Forecasting and Social Change*, 209, 123812. DOI: https://doi.org/10.1016/j.techfore.2024.123812

Wang, L. and Shao, J. (2024). The energy saving effects of digital infrastructure construction: Empirical evidence from Chinese industry. *Energy*, 130778. DOI: https://doi.org/10.1016/j.energy.2024.130778

WEF (2023). Fostering Effective Energy Transition 2023. World Economic Forum. Available online at: https://www.weforum.org/publications/fostering-effective-energy-transition-2023/digest/ [Accessed on 12 August 2024]

Wu, L., Zhu, C. and Wang, G. (2024). The impact of green innovation resilience on energy efficiency: A perspective based on the development of the digital economy. *Journal of Environmental Management*, 355: 120424. DOI: https://doi.org/10.1016/j.jenvman.2024.120424

Xu, G., Zhang, J. and Wang, S. (2024). How Digitalization and Sustainability Promote Digital Green Innovation for Industry 5.0 through Capability Reconfiguration: Strategically Oriented Insights. *Systems*, 12(9), 341. DOI: https://doi.org/10.3390/systems12090341

Ye, J. and Dela, E. (2023). The Effect of Green Investment and Green Financing on Sustainable Business Performance of Foreign Chemical Industries Operating in Indonesia: The Mediating Role of Corporate Social Responsibility. *Sustainability*, 15(14), 11218. DOI: https://doi.org/10.3390/su151411218

Zhang, Y., Liu, M. and Fu, B. (2024). Can digital technology application promote energy saving and emission reduction practices in enterprise? An empirical study based on the awareness-motivation-capability perspective. *Energy*, 286: 129636. DOI: https://doi.org/10.1016/j.energy.2023.129636

Zhao, D., Lin, J. and Bashir, M.A. (2024). Analyse the effect of energy efficiency, natural resources, and the digital economy on ecological footprint in OCED countries: The mediating role of renewable energy. *Resources Policy*, 95: 105198. DOI: https://doi.org/10.1016/j.resourpol.2024.105198

Zheng, G., Ul Haq, M.Z., Huo, B., Zhang, Y. and Yue, X. (2024). Leveraging intellectual capital for building a supply chain circular economy system: A knowledge-based view. *International Journal of Production Economics*, 109225. DOI: https://doi.org/10.1016/j.ijpe.2024.109225

Zhu, Q., Huang, S.Z. and Koompai, S. (2024). Digital Transformation as a Catalyst for Green Innovation: An Examination of High-Tech Enterprises in China's Yangtze River Delta. *Sustainable Futures*, 100277. DOI: https://doi.org/10.1016/j.sftr.2024.100277

Zhu, Y., Zhang, H., Siddik, A.B., Zheng, Y. and Sobhani, F.A. (2023). Understanding Corporate Green Competitive Advantage through Green Technology Adoption and Green Dynamic Capabilities: Does Green Product Innovation Matter? *Systems*, 11(9), 461. DOI: https://doi.org/10.3390/systems11090461.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*	*Author 3*	*Author 4*	*Author 5*
Conceived and designed the research or analysis	Yes	No	Yes	Yes	Yes
Collected the data	No	No	Yes	No	No
Contributed to data analysis and interpretation	Yes	Yes	No	Yes	No
Wrote the article/paper	Yes	Yes	Yes	Yes	Yes
Critical revision of the article/paper	No	Yes	No	Yes	No
Editing of the article/paper	Yes	Yes	Yes	Yes	Yes
Supervision	No	Yes	No	No	Yes
Project Administration	Yes	No	Yes	No	No
Funding Acquisition	No	No	No	No	No
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Research involving human bodies or organs or tissues (Helsinki Declaration)
The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

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The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. The contexts of animals were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work.

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The author(s) solemnly declare(s) that this research has not involved the plants for experiment and field studies. Some contexts of plants are also indirectly covered through literature review. Thus, during this research the author(s) obeyed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

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The author(s) solemnly declare(s) that this research has not directly involved any local community participants or respondents belonging to non-Indigenous peoples. Neither this study involved any child in any form directly. The contexts of different humans, people, populations, men/women/children and ethnic people were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

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The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

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