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GREEN ECONOMY AND SUSTAINABLE DEVELOPMENT *http://vilniustech.lt/bm*

APPLYING GREEN TECHNOLOGIES TO IMPROVE BUSINESS SUSTAINABILITY

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Abstract. Green technologies have great potential to meet economic sustainability challenges. The purpose of this paper is to review which sectors use the greenest technology and which benefits they are giving. This paper examines which business sectors are using green technologies and how effective they are. The most green technologies are used in the logistics, construction, and information technology sectors. The main factors determining the help of technology are the various problems technology addresses, such as cost increases, lack of human resources, and limited resources. Over 40 articles have been analyzed in this paper, which has led to a scientific literature analysis on technologies in business that have a low environmental impact and contribute to economic growth. The data from Eurostat EIS database collected was structured through a descriptive analysis of the application of green technologies in various business activities using generalization methods. The investigation revealed the benefits and potential that 30 percent of carbon footprint could be reduced by using artificial intelligence (AI) in business. The previous papers discussed the application of AI in one of areas and not covered several different areas, however, this paper summarizes the application of AI practices in different business areas. The study has shown that green technologies offer significant economic and environmental benefits.

Keywords: sustainability, green technology, business, logistics sector, informational technology sector, constructions sector.

JEL Classification: M2.

Introduction

Sustainability for business has advantages such as reducing business costs, improving the company's reputation, having a competitive edge, and boosting the company's bottom line (Maryville University, n.d.). The activities of innovative green companies are often subject to a financial shortage. Therefore, the financial system must develop and innovate, especially in developing countries (Lin & Ma, 2022). Utilizing inclusive green finance effectively plays a crucial role in promoting green innovation, supporting sustainable economic development, and combating climate change (Irfan et al., 2022). There is a lack of empirical and theoretical research on the effects of green technology innovation and investments on carbon dioxide (CO_2) emissions, particularly in relation to factors that may hinder progress, such as social globalization (Sharif et al., 2022). Green technologies aim to protect the environment, repair the damage caused to the environment in the past, and conserve natural resources. Green technologies are used in various sectors, such as logistics, architecture, agriculture, and AI.

The impact of technology on society and the environment is significant, and it plays a crucial role in the advancement of economies, including the modern global economy (Sreeramana & Shubharajyotsna, 2016). The main goal of this literature review is to identify the most common green technology in which sectors, which benefits they are giving, and how the pollution problem could be solved through green technology.

The article was written after analyzing over 40 other articles and doing a review of other authors findings. It consists of several sections. The paper starts with the review of green technology and its specifics. The further section identifies green business models. Later on the paper responds to the application of green technologies in different sectors: from logistics and information technology to the construction sector. The presentation of green-oriented technologies in IT sector was extended by presenting how AI could by implemented in IT delivered

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solutions for various business cases. And final chapter of paper provides conclusions.

1. Methodology

This study aimed to identify the sectors that use the greenest technologies and the benefits they provide in terms of economic sustainability. A systematic review of over 40 scientific articles was conducted, focusing on the application of green technologies in various business activities. The analysis was performed using generalization methods, and the data was structured through a descriptive analysis.

To begin, a search of various scientific databases, including Google Scholar and Science Direct, was conducted using relevant keywords, such as "green technology", "sustainability", and "business". The inclusion criteria for the articles were that they were published in peer-reviewed journals, written in English, and discussed the application of green technologies in business activities.

The selected articles were then reviewed and analyzed based on their research questions and results. The focus was on identifying the sectors that use the greenest technologies and the benefits they provide. The data was collected from the articles and structured through a descriptive analysis, which allowed for the identification of the most used green technologies and their applications in different business activities.

Furthermore, the study also analyzed the application of AI, which helps to reduce carbon footprint by 30 percent in business. The search for articles related to the application of Al in IT sector delivered solutions for logistics, agriculture and water supply was conducted using the same keywords as mentioned earlier. The articles were analyzed using a similar methodology as described above.

The findings of this study were presented using qualitative analysis. The results were discussed in the context of the existing literature and the potential benefits of green technologies and Al for economic sustainability. The limitations of the literature study were also discussed, modelling the exclusion of articles in languages other than English.

Overall, this study provides valuable insights into the sectors that use the most green technologies and the benefits they provide for economic sustainability. Additionally, it summarizes the application of Al practices in different business areas, which has not been covered comprehensively in previous literature.

2. Green technology

Green technology topics are getting more and more attention. According to data from Google scholars, in 2016–2020, authors published 5% more publications than in 2010–2015. Green technology is an umbrella term that uses technology and science to reduce human environmental impact. Green technologies cover many research areas, including energy, machinery, and pollution. Examples of environmental technologies are waste recycling, water improvement, wastewater treatment, renewable energy sources, etc.

Green architecture. The adoption of green buildings can substantially decrease the consumption of urban resources and promote sustainable urban development. By incorporating green construction methods, buildings can be designed to optimize the use of natural light and insulation, resulting in lower energy consumption. This practice reduces energy needs for lighting and heating and sometimes makes heating unnecessary. Moreover, building materials can be sourced from municipal waste and landfills to enhance sustainability. This technology will soon enable all buildings to become "passive" without generating significant additional emissions during their production and utilization (Kumar, 2013).

Biofuel. Throughout history, biomass has been a primary source of energy. The biomass sector has a significant impact on society and the environment at the local, regional, and global levels. The use of biomass as energy is associated with many conflicts and problems. The modern production methods of biofuels, which derive energy from biomass, offer significant potential to address global energy security and global food security and balance the global trade deficit. Numerous global initiatives are in progress to transform the existing energy supply system from traditional biomass conversion to modern biomass conversion (Khan et al., 2022). As it is seen in the Figure 1 biomass is produced over several generations, divided into four parts: edible, non-edible, algal, and breakthrough biomass.

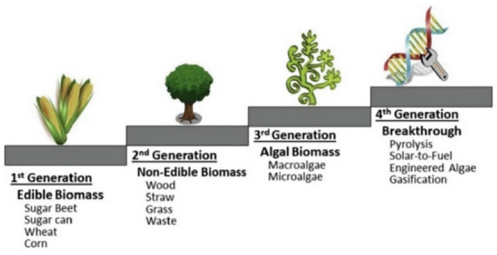

Figure 1. Distribution of biomass production over generations and categories (source: OptimizeIAS, 2023)

Electric-powered vehicles. Car ownership is expected to increase by €2.5 billion by 2050. The automotive industry has introduced many innovations to stabilize the environmental impact, moving from conventional vehicles to electric vehicles (EV) (Joshi et al., 2022).

Artificial intelligence. AI can reduce energy consumption, environmental damage, and the risk of producing harmful chemicals. However, it is still not widely used due to the high technological requirements (Liao et al., 2022).

Waste management and recycling. Creating a sustainable urban waste management system necessitates a comprehensive assessment and integration of economic, environmental, and social factors to promote sustainable development (Torkayesh et al., 2022).

Waste is translated into energy. The technologies for managing municipal solid waste are ranked in a hierarchy, which includes recycling and composting as the most preferred options, followed by energy-burning (commonly known as waste-to-energy conversion), and finally, landfilling (Psomopoulos et al., 2009).

Programmable thermostats. Smart thermostats allow you to constantly learn, remotely plan, and control the temperature in the room (Gupta & Gregg, 2022).

Low-carbon construction. Photocatalysis has been widely used as an effective technology for removing organic pollutants. A photocatalyst suitable for practical use must possess high photocatalytic activity, stability, and cost-effectiveness (Liu et al., 2022).

Carbon capture and storage. Carbon capture and storage (CCS) is critical for mitigating climate change, which is undoubtedly one of the most pressing challenges for our planet. Despite carbon dioxide emissions being a global concern for decades, progress has been inadequate, slow, and sporadic (Gür, 2022).

LED lighting. Utilizing UV and visible spectrum LED lighting is a sustainable, cost-effective, and environmentally friendly technology to enhance the quality of sprouts, micro-greens, and young leaves by increasing their health-promoting compounds while reducing energy consumption and expenses (Artés-Hernández et al., 2022).

Green materials. The increasing circular economy has led to a rapid buildup of plastic waste, resulting in a global need for high-quality renewable plastics (e.g., fully biodegradable to carbon dioxide and not producing harmful by-products) (Karan et al., 2019).

People have long been looking for sustainable solutions to meet their daily needs. However, more than ever, innovative solutions to environmental problems are in demand (Normand, 2022). Every day new or improved technologies appear that are sustainable. With that, it aims to reduce the environmental damage caused by pollution.

3. Green business models

A sustainable business model refers to a company's strategy for generating profitable returns while simultaneously safeguarding the environment and the well-being of individuals. It identifies the company's products or services, targets customers and related costs, and supplies and distribution chains (The Big Bang Partnership, 2019).

In the last twenty years, e-commerce has propelled the popularity of the business model concept, leading to a surge in research spanning various fields of application. Innovative business models can enhance an organization's sustainability efforts, aligning with the Sustainable Development Goals. The concept of a sustainable business model pertains to how a company can create, provide, and capture value sustainably across economic, social, cultural, or other contexts. Developing a sustainable business model is an innovative element of a company's overall strategy. Different industries and companies utilize sustainable business models concurrently to attain their economic, environmental, and social objectives (Nosratabadi et al., 2019).

According to Jahn et al. (2021), by adopting sustainable practices, businesses can save costs by implementing energy-efficient systems, reducing waste, and improving resource utilization, leading to lower utility bills and operational expenses. Apart from financial benefits, sustainability can enhance a business's reputation and brand image, as consumers today are becoming more aware of environmental and social issues. Thus, companies that prioritize sustainability are more likely to gain customer loyalty, higher sales, and a competitive edge in the market. Furthermore, businesses can future-proof themselves by reducing their reliance on finite resources and minimizing the risk of supply chain disruptions. For example, investing in renewable energy sources can protect businesses from price fluctuations in fossil fuel markets and help them meet future energy needs. Therefore, adopting sustainable practices not only benefits the environment but also contributes to the long-term success of a business (Jahn et al., 2021).

Further, the authors examined technologies that ensure the technology in the logistics, construction, and information technology sectors.

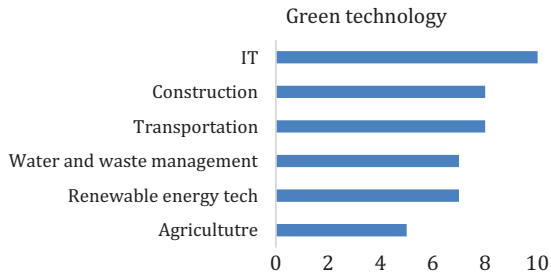

Figure 2. Three sectors leading the way in green technologies: analysis of 45 articles (source: made by the authors)

Looking at 45 articles, it can be said that the three sectors using green technologies are information technology, construction, and logistics (see Figure 2).

4. Logistics sector

In 2021, the transportation industry produced 7.7 gigatonnes (Gt) of CO_2 emissions, increasing by 8% after the pandemic restrictions were lifted. Concerns about the negative environmental impact of using fossil fuels have led to energy scarcity. This will happen due to the rapidly increasing use of diesel and other fossil fuels. Over the past few decades, the use of diesel has increased dramatically. This is due to increased industrialization and urbanization around the world. These changes will lead to major energy problems in the future. We must look at fossil fuel in search of environmentally friendly, economically advantageous, and socially just resources. These limited and dwindling resources will soon be depleted (Ansari et al., 2022).

Climate-neutral and environmentally-friendly logistics practices are crucial for the future of humanity (Carbon Care, 2023). To reach the global net-zero targets, the transportation sector needs to reduce its emissions by roughly 20% to less than 6 Gt by 2030, taking into account the expected increase in global trade demand (International Organization for Standardization [ISO], 2023).

When looking at the pollution caused by Lithuanian logistics, greenhouse gas (GHG) emissions can be observed, and the trend is increasing. The proportion of pollution caused by transportation is also on the rise. From 1990 to 2000, it fluctuated between 11% and 17%. However, between 2001 and 2010, there was a significant increase in pollution caused by transportation, and the fluctuation was between 17% and 21% during that decade. Furthermore, between 2011 and 2021, pollution has increased significantly and is growing at an even faster rate, accounting for 21–30% of all pollution (Lietuvos Respublikos Aplinkos ministerija, 2023) (see Figure 3).

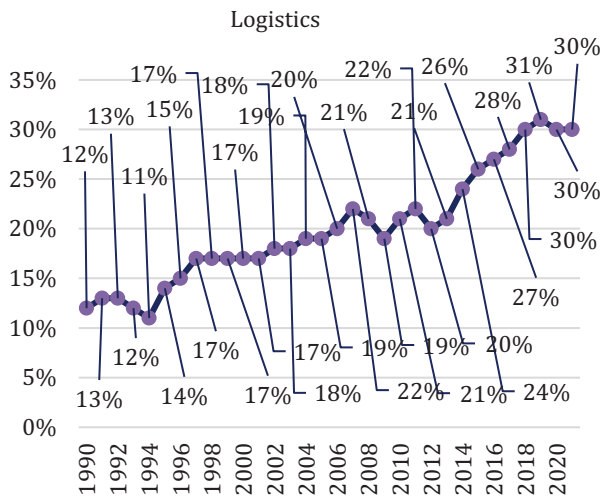

Figure 3. GHG emissions from Lithuanian logistics: trends and proportions over three decades. GHG increase in percentage (source: Lietuvos Respublikos Aplinkos ministerija, 2023)

Green logistics is a company's effort to reduce the environmental impact of its logistics operations through measurement and minimization. The goal is to gain a competitive advantage in the market by meeting the client's desire for environmentally friendly practices. Transport is a particularly important sector with a high environmental impact, as it is considered the fastest-growing source of greenhouse gas emissions. Green transport is a low-emission, environmentally friendly way of traveling. Green transport aims not only to decrease greenhouse gas emissions, air pollution, noise, and spatial use but also to diminish poverty and encourage economic growth. Transport is considered environmentally sustainable when it promotes environmental sustainability and economic and social development (Rodrigue et al., 2017).

In order to reduce air pollution, the logistics sector could utilize green transportation in cities. For example, buses in Lithuania's city centers could be powered by electricity. According to Subbotin et al. (2023), a key issue worth noting is the insufficient provision of electric transportation for the public, coupled with a shortage of gas stations to support it. One possible solution could be to draw inspiration from other countries experiences and adapt them accordingly. One notable challenge is the insufficient availability of public electric transport, compounded by a lack of refuelling stations. To address this issue, one viable approach may be to learn from the experiences of other nations and tailor them to fit the context.

Electric vehicles need to be charged. While Lithuania has many gas stations that offer diesel, gasoline, or gas, not all of them have spots for charging electric vehicles. In order to achieve a more sustainable environment, gas stations must invest in electric vehicle charging stations.

5. Construction sector

With the increasing globalization, environmental concerns are becoming more severe. While the construction industry is a vital aspect of the world economy, it generates issues such as high resource consumption, pollution, outdated construction practices, and inefficient functionality. Consequently, many nations are suggesting that existing buildings, which consume excessive energy and have poor functionality, should be revamped. Patents related to architectural and technological advancements have drawn the interest of several countries and regions globally (Li et al., 2022). The business environment worldwide is becoming increasingly competitive while also confronting a growing number of environmental issues. Therefore, commercial organizations are constantly finding new ways to improve operational efficiency and environmental friendliness, including the supply of materials. Although this varies by industry, in most cases, the purchase of materials can account for up to 70% of the organization's costs. Suppliers at the top of a supply chain provide commercial materials, which are crucial in enhancing an organization's competitiveness and reducing its environmental footprint (Tushar et al., 2022).

Green buildings encompass four primary domains: site development, material selection and minimization, energy efficiency, and indoor air quality (Ragheb et al., 2016):

One approach to mitigating the environmental impact of development is to carefully plan the area's development to minimize its impact on the natural environment. For example, heating and cooling loads will be reduced when building a building using solar energy, shading, and wind models.

To minimize the adverse effects on the environment, it is crucial to opt for durable, recycled, and locally manufactured materials. The demand for high-quality recycled products available at reasonable prices is increasing.

To create an efficient and comfortable building environment, incorporate energy-efficient designs and use

natural elements. Implement technologies that conserve resources and enhance passenger comfort and productivity while decreasing long-term operating costs and emissions.

To enhance the well-being and efficiency of occupants, it is crucial to enhance the quality of indoor air.

Reduce waste during construction and demolition, use of materials, and reuse or recycling.

The main elements of green architecture are divided into five groups (see Figure 4).

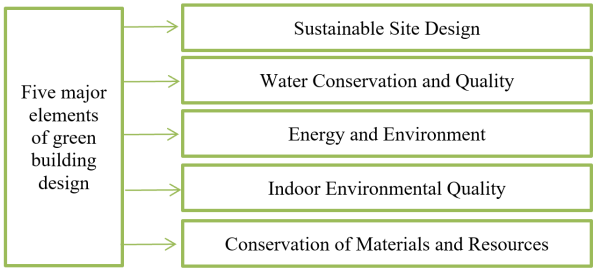

Figure 4. Five elements of green architecture for environmental sustainability (source: Ragheb et al., 2016)

These five elements contribute to the development of green architecture, which significantly impacts environmental sustainability.

Sustainable site design. The layout decisions made during a project can have a lasting effect on the building's operation. Optimizing the energy consumption of a building due to the characteristics of the plot can have a synergistic effect, and on the other hand, compromises can be found if a higher ventilation rate is needed to avoid local restrictions (Ismaeel, 2022). According to the study carried out by Navaratnam et al. (2022), the study showed that using prefabricated buildings instead of conventional ones has several benefits, such as reduced construction time, a high level of quality control, and fewer noise and disturbances.

Water conservation and quality. Technologies and strategies for preserving water are often the most inconspicuous aspects of the design strategy of the entire building. However, planning various types of water use in the building is increasingly becoming a priority. This is due to many reasons, namely, due to the increasing shortage of new and existing water resources in many regions of the country. Water efficiency refers to the planned management of water to avoid wasted resources, overuse, and exploitation. Effective water efficiency planning aims to "do more with less" without sacrificing comfort or performance (Bourg, 2016).

Energy and environment. The construction industry's energy consumption results in the emission of greenhouse gases. Therefore, aspects like green buildings, energy systems, and building technologies are significant for the sustainable development of the real estate market, construction, and the environment (Kauskale et al., 2017).

The quality of the indoor environment is important, especially in naturally ventilated schools where the polluted outdoor air can impact indoor air quality (IAQ), especially in areas with both man-made and natural sources of ambient air pollution (Sahin et al., 2022).

Conservation of materials and resources. To achieve sustainable and environmentally friendly construction, the European Union provides guidelines for using and producing raw materials for construction debris. According to these recommendations, the consumption of raw materials should not exceed 30%, and the generation of waste – no more than 40% (Malik & Marathe, 2022).

According to Ederli Marangon (2021) the construction industry is notable for its use of waste materials, particularly in the production of concrete and mortar, where they are utilized as an aggregate or supplementary cementitious material. His research has revealed the possibility of substituting traditional materials with various residues – such as marble, granite, porcelain, clay brick residue, primary pulp and paper industry sludge waste, construction and demolition waste – for the development of sustainable and environmentally-friendly mortars.

6. Information technology sector

Big data is an important source of value that creates a competitive advantage and improves business performance (Elia et al., 2022). Although digital transformation is frequently employed in the business realm, it can also be leveraged to tackle social issues such as air pollution and the aging population (Minh-Nhat et al., 2022). Moreover, the AI contribution is significant in reaching business sustainability as 30 percent of carbon footprint could be reduced with the application of this technology. Undoubtedly, AI is changing the world and will change it further. However, the power that AI brings to positive change can harm society. The recent rise of AI due to the ever-increasing amount of data and computing power has led to the rise of AI ethics, which studies the ethical and social challenges faced by creators, manufacturers, consumers, citizens, policymakers, and individual citizens, the public organization (van Wynsberghe, 2021). His development is supporting more and more industries. For example, AI is expected to impact global productivity, equity and inclusion, environmental performance, and several other short- and long-term areas. The impact of AI on sustainable development has positive and negative effects (Vinuesa et al., 2020). AI is widely used in logistics, agriculture, and in regulating water quality.

According to Lee and Kim (2020), to incorporate AI in business while minimizing e-waste, one option is to utilize cloud-based AI services. This approach allows enterprises to access AI resources and tools without the need for physical hardware, which can quickly become outdated and contribute to e-waste. Cloud-based AI services also typically use more energy-efficient infrastructure than on-premises solutions, which helps reduce the environmental impact.

Another approach is to consider the entire AI hardware and software lifecycle, from procurement to

disposal. Businesses can choose to purchase energy-efficient hardware and opt for upgradeable designs to extend the lifespan of the equipment. Proper disposal and recycling of e-waste can also help minimize the environmental impact of AI adoption (Lee & Kim, 2020).

6.1. Artificial intelligence in logistics

AI is a commonly used technology in the field of logistics and supply chain management. As data becomes more readily available and computing power increases, more opportunities exist to improve decision-making related to supply chain operations. This data can come from digital logistics applications or from IoT assets. AI can assist in automating specific workflows. Nonetheless, despite its ability to handle some tasks, we think it won't render the role of a logistics planner unnecessary (Boute & Udenio, 2022). AI gives you the power and powers and increases the capabilities of human being.

Using AI, sensor networks, and cloud computing to improve automated warehousing logistics processes can improve customer satisfaction by allowing customers to avoid incorrect orders and improve freight handling efficiency. With sensors, label scanners, and barcode scanners, automated process automation can accurately recognize product types and act as independent tractors and forklifts. These systems are designed to receive and process information from sensors, label scanners, and barcode scanners to ensure the correct placement of products on the relevant shelves (Pandian, 2019). Thus, in this way, the likelihood of errors would be reduced, and when using AI in warehouses, it can be predicted that the customer would be much happier and more loyal to a company that does not make mistakes or makes hugely few of them.

6.2. Artificial intelligence in the agriculture

AI has become a promising technology in digital agriculture. Digital agriculture refers to using digital technologies to collect, store and further analyze electronic agricultural data to use AI technology for better reasoning and decision-making. One such method is precision agriculture, which monitors the soil's moisture and composition, temperature, and humidity and determines the optimal need for fertilizers and water for specific plants and different areas of farms. Then there are computer vision and machine learning techniques to detect plant diseases and defects and identify weeds that can help spray only the above-ground parts of diseased or weed-infected plants and not the entire field. AI in agriculture can help develop agricultural methods to increase crop yields and reduce the above challenges (Singh & Kaur, 2022).

Advanced applications such as AI, cloud machine learning, satellite imagery, and sophisticated analytics make the agricultural industry a smart, efficient, and sustainable ecosystem. These combined technologies allow farmers to achieve higher yields per hectare and better regulate food grain prices, ensuring their profitability. AI models allow you to accurately determine the optimal sowing periods in different seasons, climate statistics, real-time moisture suitability data from daily precipitation statistics, and soil moisture to compile detailed forecast charts. The models also consider farmers' contribution to the best time for sowing (Dharmaraj & Vijayanand, 2018).

6.3. The use of artificial intelligence to determine water quality

AI technology has demonstrated its effectiveness in aiding decision-making across various domains, particularly on environmental systems and membrane processes. AI allows the system to operate cost-effectively, including better planning and monitoring and a comprehensive understanding of real-time resource loss, which maximizes tax revenues and satisfaction with water quality. This study aims to present a detailed analysis of the existing use of AI-based tools for the modelling of membrane processes, as well as the potential use of these models in other areas where membranes will be utilized in the future (Viet et al., 2022).

AI models have shown great success and superiority in processing non-linear data due to increased accuracy, robustness, reliability, cost-effectiveness, ability to solve problems, ability to make decisions, and efficiency in handling such data (Tung & Taseen, 2020).

7. Summary of the application of green technologies in logistics, construction and IT sectors

Recently, there has been an increasing focus on utilizing environmentally friendly technologies. The authors analyzed the application of technology and found that mainly environmentally friendly technologies are applied in countries such as Malta, Bulgaria, and Denmark (see Figure 5).

In the course of the analytical study, the authors applied the ontology of the electric field to show the relationship between the sustainable use of resources

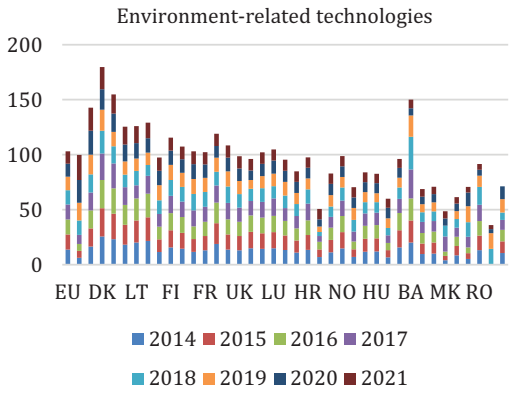

Figure 5. Development of environment-related technologies, % all technologies by countries and years (accumulated percentage) (source: Eurostat, 2022)

and technology and, based on the information presented in the article above, seek to classify the technology accordingly.

As shown in Figure 6, green technologies are most used in business in 3 sectors: logistics, information technology, and construction. Each sector is explained what the technologies are and areas that use green technologies.

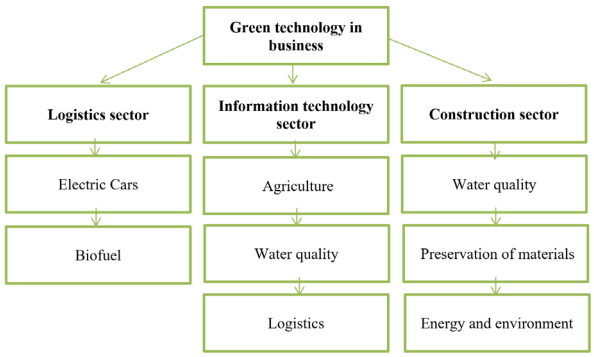

Figure 6. Green Technologies adoption in three business sectors: logistics, information technology, and construction (source: constructed by the authors)

The presented classification of technologies also has some limitations. The study did not examine in detail:

various applications – manufacturing, sustainable urban, smart grids, and other technologies;

the influence of the application of technology on business finances.

8. Discussion

The purpose of this study was to review the sectors that use green technologies and identify the benefits they provide for economic sustainability. The study found that logistics, construction, and information technology sectors are the most significant users of green technologies, and these technologies can provide several benefits such as carbon footprint and waste reduction (Lee et al., 2020). The analysis also revealed that the application of AI in different business areas can significantly contribute to business sustainability, which is particular important seeking to reach zero emission in logistics, agriculture and water supply (Bukhari et al., 2022). However, it's important to note that this study does not cover every use of AI in business. The analysis only provides an overview of AI practices in different sectors, which suggests that AI can improve decision-making, reduce human resource requirements, and increase efficiency. Future research should investigate the various uses of AI in business and explore its potential for contributing to economic sustainability further.

The study's findings provide valuable insights into the benefits of green technologies in different sectors and their potential for economic sustainability. The analysis highlights the importance of adopting green technologies in business, particularly in sectors that have a high environmental impact and resource requirements. The application of AI in business also offers significant potential for improving efficiency and reducing costs.

However, there are some limitations to this study that should be considered. Firstly, the analysis only covers the most common uses of AI in business and may not represent the full range of AI practices. Secondly, the study did not include a quantitative analysis, which could have provided more precise insights into the extent of the benefits of green technologies and AI. Finally, the analysis only covers the use of AI in business and does not consider the broader ethical and societal implications of AI.

Conclusions

Scientific research in the selected topic mainly focuses on implementing sustainable development requirements, achieving the goals of green education programs, and evaluating technologies. Researchers have published studies, conducted analytical studies, and classified methods to improve environmental sustainability. It is notable that the number of publications on green technologies is increasing. The authors have compared the number of publications across different periods and found that between 2016 and 2020, the number of publications increased by 5% compared to the previous five-year period. In this article, the authors connect green and environmentally friendly technologies, distinguishing six groups, and describing their impact on the sustainable use of resources.

The authors highlight the contribution of AI to gain sustainable technology application practices. The results of the research are important for policy makers, as sponsoring AI could foster the way to enlarge sustainability deliverables. From such results would benefit society when these foreseen activities affect the conditions of living.

The authors classified green technologies according to their application in different sectors and analyzed the application of technologies in other countries. In the article, the authors determined which countries of the European Union are most actively applying environmentally friendly technologies.

The authors analyzed which sectors are most often mentioned in articles published on the topic of green technologies and found that the following three main sectors are mentioned among the sectors: logistics, information technology, and construction. The main factors contributing to the benefits of applying green technology are the ability to solve various problems in business. Among the technologies relevant to the IT sector is AI, which is widely applied to the problems of determining the quality of agriculture and water.

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Author contributions

The authors declare their participation in the writing of the article: analysis and evaluation of technologies – Gintarė Byčenkaitė, review, and generalization of the article – Aurelija Burinskienė.

Disclosure statement

The authors declare that they have no financial, professional, or personal interests that could influence the preparation of the article.

References

Ansari, K., Goga, G., & Mohan, R. (2022). Utilization of food waste into ethanol and biodiesel. *Materials Today: Proceedings*, *65*, 3596–3601. https://doi.org/10.1016/j.matpr.2022.06.160

Artés-Hernández, F., Castillejo, N., & Martínez-Zamora, L. (2022). UV and visible spectrum LED lighting as abiotic elicitors of bioactive compounds in sprouts, microgreens, and baby leaves – a comprehensive review including their mode of action. *Foods*, *11*(3), 265. https://doi.org/10.3390/foods11030265

Bourg, J. (2016). *Water conservation*. Whole building design guide. https://www.wbdg.org/resources/water-conservation

Boute, R. N., & Udenio, M. (2022). AI in logistics and supply chain management. In M. Udenio & R. N. Boute (Eds.), *Global logistics and supply chain strategies for the 2020s: Vital skills for the next generation* (pp. 49–65). Springer International Publishing. https://doi.org/10.1007/978-3-030-95764-3_3

Bukhari, J., Somanagoudar, A. G., Hou, L., Herrera, O., & Merida, W. (2022). *Zero-emission delivery for logistics and transportation: Challenges, research issues, and opportunities*. arXiv. arXiv:2205.15606. https://doi.org/10.1007/978-3-030-38948-2_107-1

Carbon Care. (2023). *Reduce emissions: The responsibility of transport and logistics*. https://www.carboncare.org/en/climate-change.html

Dharmaraj, V., & Vijayanand, C. (2018). Artificial intelligence (AI) in agriculture. *International Journal of Current Microbiology and Applied Sciences*, *7*(12), 2122–2128. https://doi.org/10.20546/ijcmas.2018.712.241

Elia, G., Raguseo, E., Solazzo, G., & Pigni, F. (2022). Strategic business value from big data analytics: An empirical analysis of the mediating effects of value creation mechanisms. *Information & Management*, *59*(8), 103701. https://doi.org/10.1016/j.im.2022.103701

Eurostat. (2022). European innovation statistics. https://ec.europa.eu/eurostat/statistics-explained

Gupta, R., & Gregg, M. (2022). Building performance evaluation of low-energy dwellings with and without smart thermostats. *Building Services Engineering Research and Technology*, *43*(3), 297–318. https://doi.org/10.1177/01436244221077344

Gür, T. M. (2022). Carbon dioxide emissions, capture, storage and utilization: Review of materials, processes and technologies. *Progress in Energy and Combustion Science*, *89*, 100965. https://doi.org/10.1016/j.pecs.2021.100965

Irfan, M., Razzaq, A., Sharif, A., & Yang, X. (2022). Influence mechanism between green finance and green innovation: Exploring regional policy intervention effects in China. *Technological Forecasting and Social Change*, *182*, 121882. https://doi.org/10.1016/j.techfore.2022.121882

Ismaeel, W. S. (2022). Sustainable site selection using system dynamics; case study LEED-certified project. *Architectural Engineering and Design Management*, *18*(4), 368–386. https://doi.org/10.1080/17452007.2021.1889955

International Organization for Standardization. (2023). *Towards a net-zero logistics sector*. https://www.iso.org/contents/news/2023/01/a-net-zero-logistics-sector.html

Jahn, S., Kunz, N., & Hoess, M. (2021). Sustainable business models: Conceptual foundations, characteristics, and insights for future research. *Journal of Business Research*, *129*, 793–804. https://doi.org/10.1016/j.jbusres.2021.01.053

Joshi, N., Malhotra, M., & Singh, J. (2022). Assessing adoption intention of electric vehicles in India: The mediating role of government policies. *European Journal of Transport & Infrastructure Research*, *22*(1), 77–96.

Karan, H., Funk, C., Grabert, M., Oey, M., & Hankamer, B. (2019). Green bioplastics as part of a circular bioeconomy. *Trends in Plant Science*, *24*(3), 237–249. https://doi.org/10.1016/j.tplants.2018.11.010

Kauskale, L., Geipele, I., Zeltins, N., & Lecis, I. (2017). Environmental and energy aspects of construction industry and green buildings. *Latvian Journal of Physics and Technical Sciences*, *54*(2), 24–33. https://doi.org/10.1515/lpts-2017-0010

Khan, S., Naushad, M., Iqbal, J., Bathula, C., & Ala'a, H. (2022). Challenges and perspectives on innovative technologies for biofuel production and sustainable environmental management. *Fuel*, *325*, 124845. https://doi.org/10.1016/j.fuel.2022.124845

Kumar, S. (2013, June 26). *Top 10 green technologies that give us hope for a sustainable future*. UC Berkeley. https://mdp.berkeley.edu/sadhika-kumar-top-10-green-technologies-that-give-us-hope-for-a-sustainable-future/

Lee, K. C., & Kim, T. (2020). AI for sustainability: Opportunities, challenges, and future directions. *Sustainability*, *12*(8), 3230. https://doi.org/10.3390/su12083230

Li, X., Huang, Y., Li, J., Liu, X., He, J., & Dai, J. (2022). The mechanism of influencing green technology innovation behavior: Evidence from Chinese construction enterprises. *Buildings*, *12*(2), 237. https://doi.org/10.3390/buildings12020237

Liao, M., Lan, K., & Yao, Y. (2022). Sustainability implications of artificial intelligence in the chemical industry: A conceptual framework. *Journal of Industrial Ecology*, *26*(1), 164–182. https://doi.org/10.1111/jiec.13312

Lietuvos Respublikos Aplinkos ministerija. (2023). *ŠESD apskaitos ir prognozių ataskaitos, nacionaliniai pranešimai*. https://am.lrv.lt/lt/veiklos-sritys-1/klimato-kaita/sesd-apskaitos-ir-prognoziu-ataskaitos-nacionaliniai-pranesimai

Lin, B., & Ma, R. (2022). How does digital finance influence green technology innovation in China? Evidence from the financing constraints perspective. *Journal of Environmental Management*, *320*, 115833. https://doi.org/10.1016/j.jenvman.2022.115833

Liu, X., Yang, Z., Yang, Y., & Li, H. (2022). Construction of carbon quantum dots sensitized porous carbon nitride/titanium dioxide nanosheets for enhancing visible light photocatalytic degradation of tetracycline. *Journal of Environmen-*

tal Chemical Engineering, *10*(4), 108083. https://doi.org/10.1016/j.jece.2022.108083

Malik, J. A., & Marathe, S. (Eds.). (2022). *Ecological and health effects of building materials*. Springer. https://doi.org/10.1007/978-3-030-76073-1

Marangon, E. (2020). Sustainable construction materials through recycling: A review. *Journal of Cleaner Production*, *257*, 120565. https://doi.org/10.1016/j.jclepro.2020.120565

Minh-Nhat, H. O., Nguyen, H. L., & Mondal, S. R. (2022). Digital transformation for new sustainable goals with human element for digital service enterprises: An exploration of factors. In R. Islam, S. R. Mondal, H. K. Pal, & S. S. Islam (Eds.), *Sustainable development and innovation of digital enterprises for living with COVID-19* (pp. 85–103). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-2173-5_6

Navaratnam, S., Satheeskumar, A., Zhang, G., Nguyen, K., Venkatesan, S., & Poologanathan, K. (2022). The challenges confronting the growth of sustainable prefabricated building construction in Australia: Construction industry views. *Journal of Building Engineering*, *48*, 103935. https://doi.org/10.1016/j.jobe.2021.103935

Normand, A. (2022, February 16). Everything you need to know about green technology in 2023. *Greenly Earth.* https://greenly.earth/en-us/blog/ecology-news/everything-you-need-to-know-about-green-technology-in-2022

Nosratabadi, S., Mosavi, A., Shamshirband, S., Zavadsk, E. K., Rakotonirainy, A., & Chau, K. W. (2019). Sustainable business models: A review. *Sustainability*, *11*(6), 1663. https://doi.org/10.3390/su11061663

OptimizeIAS. (2023, April 20). *FCI rice to be used for ethanol production*. https://optimizeias.com/fci-rice-to-be-used-for-ethanol-production/

Pandian, A. P. (2019). Artificial intelligence application in smart warehousing environment for automated logistics. *Journal of Artificial Intelligence*, *1*(2), 63–72. https://doi.org/10.36548/jaicn.2019.2.002

Psomopoulos, C. S., Bourka, A., & Themel, N. J. (2009). Waste-to-energy: A review of the status and benefits in USA. *Waste Management*, *29*(5), 1718–1724. https://doi.org/10.1016/j.wasman.2008.11.020

Ragheb, A., El-Shimy, H., & Ragheb, G. (2016). Green architecture: A concept of sustainability. *Procedia-Social and Behavioral Sciences*, *216*, 778–787. https://doi.org/10.1016/j.sbspro.2015.12.082

Rodrigue, J. P., Slack, B., & Comtois, C. (2017). Green logistics. In H. Kotzab, S. Seuring, M. M. Skjoett-Larsen, & J. Teller (Eds.), *Handbook of logistics and supply chain management* (4th ed., pp. 589–606). Emerald Group Publishing Limited.

Sahin, C., Rastgeldi Dogan, T., Yildiz, M., & Sofuoglu, S. C. (2022). Indoor environmental quality in naturally ventilated schools of a dusty region: Excess health risks and effect of heating and desert dust transport. *Indoor Air*, *32*(7), e13068. https://doi.org/10.1111/ina.13068

Sharif, A., Saqib, N., Dong, K., & Khan, S. A. R. (2022). Nexus between green technology innovation, green financing, and CO_2 emissions in the G7 countries: The moderating role of social globalisation. *Sustainable Development*, *30*(3), 433–446. https://doi.org/10.1002/sd.2259

Singh, P., & Kaur, A. (2022). A systematic review of artificial intelligence in agriculture. In P. Singh & A. Kaur (Eds.), *Deep learning for sustainable agriculture* (pp. 57–80). Springer International Publishing. https://doi.org/10.1016/B978-0-323-85214-2.00011-2

Sreeramana, A., & Shubhrajyotsna, A. (2016). Opportunities and challenges for green technology in the 21st century. *Journal of Environmental Management*, *183*(Part 3), 808–815. https://doi.org/10.1016/j.jenvman.2016.07.041

Subbotin, A. S., Konchakov, D. I., Karavashkina, E. A., & Dolzhko, D. B. (2023, January 1). Development of electric transport and construction of transport infrastructure in the conditions of design for the renovation of small towns. *Transportation Research Procedia*, *63*, 704–711.

The Big Bang Partnership. (2019). *What is a sustainable business model?* https://bigbangpartnership.co.uk/sustainable-business-model-innovation/

Torkayesh, A. E., Tavana, M., & Santos-Arteaga, F. J. (2022). A multi-distance interval-valued neutrosophic approach for social failure detection in sustainable municipal waste management. *Journal of Cleaner Production*, *336*, 130409. https://doi.org/10.1016/j.jclepro.2022.130409

Tung, T. M., & Yaseen, Z. M. (2020). A survey on river water quality modelling using artificial intelligence models: 2000–2020. *Journal of Hydrology*, *585*, 124670. https://doi.org/10.1016/j.jhydrol.2020.124670

Tushar, Z. N., Bari, A. M., & Khan, M. A. (2022). Circular supplier selection in the construction industry: A sustainability perspective for the emerging economies. *Sustainable Manufacturing and Service Operations Management*, *1*, 100005. https://doi.org/10.1016/j.smse.2022.100005

Maryville University. (n.d.). *The importance of environmental awareness when running a business*. Retrieved March 31, 2023, from https://online.maryville.edu/blog/importance-of-environmental-awareness-when-running-a-business

van Wynsberghe, A. (2021). Sustainable AI: AI for sustainability and the sustainability of AI. *AI and Ethics*, *1*(3), 213–218. https://doi.org/10.1007/s43681-021-00043-6

Viet, N. D., Jang, D., Yoon, Y., & Jang, A. (2022). Enhancement of membrane system performance using artificial intelligence technologies for sustainable water and wastewater treatment: A critical review. *Critical Reviews in Environmental Science and Technology*, *52*(20), 3689–3719. https://doi.org/10.1080/10643389.2021.1940031

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M. & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications*, *11*(1), 1–10. https://doi.org/10.1038/s41467-019-14108-y