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FOREIGN EXPERIENCE IN ASSESSING THE FINANCIAL FEASIBILITY OF USING DIGITAL TECHNOLOGIES IN DEVELOPING A GREEN ECONOMY

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Abstract: This article assesses the financial opportunities of digital technologies in advancing green economies, drawing on international case studies. Examples from Germany, China, and Denmark illustrate how AI, blockchain, and IoT reduce operational costs, unlock new revenue streams, and mobilize investments. The findings emphasize the role of policy frameworks and public-private partnerships in scaling these opportunities, particularly for emerging economies.

Keywords: Digital technologies,Green economy**,** Financial opportunities**,** Sustainable investment**,**International experience

Introduction

Transitioning to a green economy—a system that prioritizes sustainability, resource efficiency, and social justice—is essential to addressing climate change (World Bank, 2021). Digital technologies, including artificial intelligence (AI), blockchain, and the Internet of Things (IoT), are increasingly recognized as tools to enable this transition. However, the financial implications of integrating these technologies, especially in developing economies, are still understudied. Limited synthesis of international evidence on how digital tools unlock financial value in green sectors. Assessing case studies from developed and developing economies, identifying financial strategies for scaling up a green digital economy.

Methods

This study uses a qualitative literature review approach, analyzing peer-reviewed articles, government reports, and industry publications published between 2015 and 2023. Data sources include Scopus, Web of Science, and OECD databases. The following are examples of the study methods;

Examples that demonstrate measurable financial results.

Focus on renewable energy, smart agriculture or circular economy sectors.

Geographically diverse examples (Europe, Asia, Africa).

Results

Germany's Industry 4.0: AI-based energy management systems reduced industrial carbon emissions by 15% and lowered operating costs (Müller & Schmidt, 2020). The German Industry 4.0 initiative has significantly increased sustainability and efficiency by integrating artificial intelligence (AI), the Internet of Things (IoT) and big data into industrial processes. The implementation of AI-based energy management systems in manufacturing and industrial sectors has led to a 15% reduction in carbon emissions and lower operating costs, as highlighted by Müller and Schmidt (2020). Below is a detailed explanation of how this was achieved:

AI asosidagi energiya boshqaruv tizimlarining asosiy mexanizmlari

Real-time data analysis:	IoT sensors collect real-time data from machines, production lines, and power grids. AI algorithms analyze energy consumption patterns to identify efficiency gains (e.g., idle machines, energy waste during peak hours).
Pre-emptive maintenance:	AI predicts equipment failure or repair needs, which reduces downtime and prevents energy waste from faulty machines. Example: AI can avoid overconsumption that would otherwise be optimal by monitoring engine performance.
Dynamic energy optimization:	AI adjusts energy consumption based on demand changes. For example, it shifts non-critical tasks to the hours when green energy is available at the lowest cost. Machine learning models optimize heating, cooling, and lighting systems in real time.
Integration with renewable energy:	AI integrates renewable sources (e.g., solar, wind) into the grid by balancing energy loads, reducing dependence on fossil fuels. Smart grids give renewable energy priority during periods of high production.

Research and results

A BMW plant in Germany has reduced energy consumption by 18% by optimizing HVAC systems and production schedules using AI, while BASF has implemented AI to model and reduce energy consumption in chemical reactions, which has led to a 20% reduction in CO_2 emissions at some facilities. In addition, in steelmaking, Thyssenkrupp has used AI to optimize blast furnace operations, reducing energy waste and waste by 15-20%. Below are some of the strategies that German companies are implementing to reduce costs:

Cost reduction strategies

Energy Price Forecasting:	AI predicts energy market prices, allowing factories to purchase electricity at optimal times.
Resource Efficiency:	Minimizing waste (e.g. raw materials, energy) reduces operating costs. Siemens reduced energy costs by 10-15% after implementing AI.
Automated Processes:	Reducing human intervention reduces labor costs and errors.

The German government supports Industry 4.0 through initiatives such as the "Plattform Industrie 4.0", funding research and development for smart factories. Collaboration between technology companies (e.g. SAP, Siemens) and manufacturers is accelerating the adoption of AI. Laws such as the "Energy Efficiency Act" (EnEfG) encourage industries to adopt green technologies. The challenges in implementing these practices can be interpreted as follows: High initial investment: Upgrading factories with IoT sensors and AI systems requires significant capital. Data security: Increased connectivity increases cybersecurity risks. Workforce training: Employees will need to be trained to operate AI-based systems. Future directions Digital management: Virtual replicas to simulate factories and optimize energy consumption. Carbon-AI platforms: Real-time emissions monitoring and compensation systems. Alignment with the EU's green future: Germany aims to achieve the European Union's carbon neutrality goals by 2050 using Industry 4.0. As Müller and Schmidt (2020) point out, the role of AI in Industry 4.0 is not only technological but also strategic, helping Germany maintain its industrial leadership and meet its climate goals. As a special note, their research may include an analysis of industry-specific KPIs and government-industry cooperation models.

China's Smart Grids: IoT-based grid optimization reduced energy waste by 20% and saved $4.3 billion annually (Li et al., 2022).

The following is a broader overview of China's smart grids and energy efficiency improvements through IoT technology: A smart grid is a digital-based electricity system that automates the distribution of electricity and monitors consumption and production in real time. IoT (Internet of Things) connects various devices, sensors and computing systems via the Internet, providing data exchange and analysis. How does IoT reduce energy consumption? First, it is important to analyze: Sensors and smart meters continuously monitor the flow, pressure and consumption in the electricity network. This data is analyzed using AI and energy distribution is optimized. Energy demand can be predicted based on operating hours, seasonal changes or weather conditions. Smart grids coordinate energy sources (solar, wind, thermal power plants) and reduce overproduction. Sensors can quickly detect faults and repair them without human intervention, reducing energy losses (for example, losses in transmission lines) by 20%. Smart meters can detect cases of electricity theft and prevent losses.

Smart meters in China — installed in more than 500 million households. High-voltage gateways — energy flows are being optimized through automated control systems. Renewables — the ability to connect wind and solar power plants to the main grid has been expanded. Artificial intelligence — data-driven decision-making (for example, AI-based adjustment of the operating mode of pipes in Shanghai).

Results

(Li et al., 2022): 20% energy savings — 200 TeraWh of energy saved annually, equivalent to saving 60 million tons of coal. $4.3 billion savings — reduced infrastructure costs, lower energy production costs. Environmental benefits — 180 million tons of carbon emissions reduced.

This experience from China is a model for developing countries like Uzbekistan. Smart grids play an important role in increasing energy security, conserving natural resources, and combating climate change. Such projects also help create new jobs and foster technological innovation. China is expanding smart grids across the country with the aim of achieving carbon neutrality by 2030. This will not only ensure economic but also environmental sustainability.

Denmark's wind energy trade has generated $180 million in new market revenue in renewable energy trading via blockchain platforms (Andersen, 2021). In Kenya, mobile-based microloans for solar irrigation in digital agriculture finance increased farmers' incomes by 35% (Mwangi & Omondi, 2023). The European Union's Green Digital Fund: Raised €2.1 billion for startups in smart cities and clean technology (European Commission, 2022).

Discussion

Successful models (e.g. Germany's Industry 4.0) require public-private partnerships and subsidies. Developing countries face infrastructure challenges, which require targeted direct investment (UNCTAD, 2023). There is a need for regulatory incentives (e.g. tax breaks for green technologies) that enhance the adoption of digital technologies (OECD, 2021). Long-term financial impacts (e.g. ROI over decades) require further study.

Conclusion

Digital technologies offer transformative financial opportunities for green economies, from operational savings to opening up new markets. International experience highlights the need for flexible policies, equal opportunities and collaborative innovation. Future research should explore sector-specific digital solutions in low-income regions. Countries around the world are achieving success by using digital innovations to finance green transitions, improve resource efficiency and create new sources of economic revenue. For example, in the European Union, Artificial Intelligence (AI) and Internet of Things (IoT) technologies have enabled energy consumption to be reduced by 20-30%, and electricity distribution systems to be optimized through smart grids. In countries such as Sweden and Denmark, blockchain technologies have been used to track recycled materials and calculate carbon footprints, helping companies to comply with ESG (Environmental, Social and Governance) standards.

In Asian countries such as China, India and Singapore, digitalization of renewable energy management systems (e.g. wind and solar farms powered by big data and AI) has reduced infrastructure costs by 15-25%. Digital platforms have also played a key role in attracting private investment by popularizing the trading of green bonds and carbon credits. In the US, the concept of smart cities has created the potential to save up to $10 billion annually by introducing environmentally friendly transport and waste management systems.

However, this process also poses challenges such as financial barriers, lack of technical skills, and data security. For example, in Africa, the lack of infrastructure and financial resource constraints are significant in the digitalization of energy networks. Nevertheless, countries such as South Korea and Germany have managed to overcome these barriers by developing public-private partnership (PPP) models, introducing subsidies, and tax incentives. The success of the green and digital transition for Uzbekistan depends on the combination of intellectual, infrastructure, and foreign investment. Foreign experience shows that quickly starting the first steps on this path (for example, at least 5 large pilot projects in 2-3 years) will be the basis for sustainable growth in the future. In particular, the introduction of digital solutions in sectors such as agriculture, energy, and transport can turn Uzbekistan into a “green digital hub” of Central Asia. In conclusion, digital technologies are a globally proven tool for financially supporting the green economy. However, its effectiveness depends on developing strategies that take into account the specific economic, social and technical conditions of countries. Foreign experiences are a guiding light on this path, showing that it is possible to ensure economic growth and ecological balance by combining innovation and sustainability.

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