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Divergent Paths, Shared Goals: Green Finance Development in the V4 Countries

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Abstract: Green finance has long been the cornerstone of sustainable development, with mechanisms and financial instruments serving to support low-carbon growth and climate resilience. This article considers the evolution of green finance in the Visegrad Four nations (the Czech Republic, Hungary, Poland, and Slovakia) and how they compare regarding progress, challenges, and alignment with European Union sustainability objectives.Though they have a shared past and dependence on fossil fuels, the V4 countries are all growing at different rates. Poland pioneered the issuance of the world's first sovereign green bond in 2016 and remains at the forefront with new-bank innovative products and high levels of government participation. Hungarian growth is spearheaded by the Hungarian Central Bank, which has launched green mortgage bonds and regulatory incentives to introduce environmental, social, and governance (ESG) considerations into financial markets. The Czech Republic has focused on establishing regulatory pillars, but implementation is slow and fragmented. Slovakia, on the other hand, relies on EU funding and national government schemes as well, with minimal domestic green financial tools. The analysis highlights both opportunities and barriers. While EU frameworks such as the Green Deal and Taxonomy Regulation provide strong incentives, national disparities in regulatory capacity, private sector engagement, and market maturity hinder convergence. Key challenges include reliance on fossil fuels, information asymmetries, and limited awareness among businesses and households. The study concludes that greater regional cooperation, increased transparency, and the development of cross-border financing mechanisms could strengthen the V4's green transition. A joint V4 Green Bond Fund and ESG-focused education initiatives are proposed as pathways to accelerate sustainable finance in the region. Ultimately, effective green finance can deliver long-term environmental, economic, and social benefits, positioning the V4 countries as competitive actors in Europe's shift toward climate neutrality.

Keywords: Green finance, Sustainable development, Visegrad four, EU green deal, Comparative analysis

Introduction

In recent years, sustainability has emerged as a global priority, driven by ongoing climate change, biodiversity loss, declining water supplies, growing waste, and the pollution of air and water. Ensuring sustainable development is one of the defining challenges of the 21st century, with climate protection and the transition to environmentally responsible economic systems at its core. The concept of sustainable economic development has long been debated at the international level, bringing together governments, global and national institutions, and organizations to implement joint environmental initiatives.

Despite progress, significant gaps remain in fulfilling international commitments to sustainable and climate-resilient development, much of which requires substantial financial resources. Redirecting the financial system toward sustainable finance is therefore critical to enabling this transition. Global capital market actors play a decisive role, as their investment choices can either accelerate or impede the growth of green economic activities. Strategic allocation of financial resources is thus essential for implementing effective climate change mitigation strategies.

Climate threats can affect the financial system both directly and indirectly. Direct threats are especially severe if the financial system is still highly exposed to high-emitting sectors or direct exposure to climate impacts. Finance has been a major driver of human advancement since the Industrial Revolution, mobilizing the world's savings into productive purposes. Today, supporting sustainable investments, reducing carbon footprints, enhancing energy efficiency, and conserving natural resources all depend on specially tailored financial solutions.

Green finance is a vital term employed to tackle the financial dimension of sustainability. Green finance comprises financial instruments and facilities designed to facilitate investment that is green and climate risk management, such as green bonds, sustainability-linked loans, and ESG investments. Green finance can be utilized by public and private sector organizations to facilitate international environmental objectives. In particular, sustainable finance is not only an ethical or moral imperative – it is also good business sense, as long-term sustainable business models tend to generate more stable returns with less risk. As the world economy adjusts to climate change, corporations and investors are turning to green finance, investing in improved tools to assess green opportunities and risks, and developing new financing solutions. Advances in digital technology and data analytics are also increasingly enabling financial institutions to track environmental exposures in their portfolios and structure their operations to capitalize on it.

Green finance thus plays a crucial role as policy and finance instrument. All kinds of actors – policymakers, regulators, banks, investors, academia, NGOs, and financial institutions – are having a direct impact on the meaning of ‘green’ in practice. Green finance is not only supposed to finance green projects but to make the entire financial system climate- and environment-conscious and help institutions manage their environmental and climate risks. Essentially, green finance directs financial flows to socially and environmentally sustainable investment. It not only safeguards ecosystems but also promotes social equity by financing renewable energy, improving energy efficiency, encouraging circular economy trends, and expanding low-emission transport networks. It also improves financial transparency, corporate governance, and social inclusion.

The Visegrad Four (V4) – the Czech Republic, Hungary, Poland, and Slovakia – are addressing the challenges of the green transition at different speeds and with different strategies, despite their shared historical and economic background. Variations in economic structures, energy mixes, and political priorities shape how each country implements green financing. While some countries lead in issuing green bonds and integrating renewable energy, others still struggle with fossil fuel dependence, slowing the transition. The European Green Deal provides a broad EU strategy to achieve climate neutrality by 2050. However, there remain enormous gaps between Member States in the approach used at the national level. In the case of the V4, climate ambitions of EU scale always face obstacles in the guise of energy security needs, public protest, or lack of investment capacity.

This study aims to offer a comprehensive overview of green finance within the Visegrad Four, examining both achievements and aspirations while highlighting commonalities and national specificities. Each chapter explores green and sustainable finance within the broader sustainability framework, clarifies related concepts, and outlines the functioning of green finance in V4. The analysis is based on data and reports from Eurostat, the OECD, IMF, and the European Investment Bank (EIB), supplemented by relevant national and international literature and studies.

Literature Review

In the 21st century, green finance has become indispensable for both economic and environmental progress. All countries, whether developed or developing, need to pursue it (Mohd & Kaushal, 2018), as the transition to a fair and sustainable economy requires major investments (European Environmental Agency, 2024). The 2008 global financial crisis brought green finance to the forefront as a mechanism for the private financial sector to address climate challenges, while also creating new profit opportunities (Olaf & Amr, 2019; Bozsik et al., 2024). Scholars argue that developing a green economy can drive conservation investment, carbon market

instruments, and even the creation of green central banks (Sachs et al., 2019). Mainstreaming green finance is essential to reduce reliance on fossil fuels and cut emissions (Volz, 2018).

By directing capital to sustainable activities, green finance supports both environmental gains and financial returns, aligning with the UN Sustainable Development Goals (Arup, 2021). It is broadly defined as structured financial activities designed to improve environmental outcomes and resilience (Diwan & Kharas, 2022). In practice, it helps set standards for measuring environmental impacts and guides institutions toward sustainable decision-making (Zhou & Cui, 2019).

Green finance aims to mobilize resources from public, private, and non-profit actors toward sustainability priorities. Its core elements include managing environmental and social risks, capturing economic opportunities that combine profit with positive impact, and ensuring accountability (Eyraud et al., 2013). According to Diwan and Kharas (2022), green finance spans three areas: sustainable infrastructure (particularly energy system transitions), adaptation and resilience (with nature-based solutions), and transforming agriculture and land use to protect biodiversity. Lindenberg (2014) similarly identifies three segments: financing green investments, supporting public policies that incentivize sustainability, and reinforcing green-related elements of the financial system, such as green bonds.

Green Finance: Objectives, Benefits, and Challenges

Streimikiene and Kaftan (2021) identify two core purposes of green finance: reducing risk perception and mitigating environmental impacts. Similarly, Feng et al. (2023) frames its goal as promoting the coordinated development of economic, environmental, and social systems in pursuit of sustainable development, a view also reflected in Salazar's (1998) work. UNEP (n.d.) defines the primary aim of green finance as increasing financial flows that support sustainability priorities. Key to this is managing environmental and social risks, seizing opportunities that generate both financial returns and environmental benefits, and enhancing accountability. According to Park and Kim (2020), green finance also fosters the growth of sustainable industries and supports the adoption of technologies and practices that reduce carbon emissions and address climate change. Mishra & Kannaujia (2023) point out the objective of harmony between economy and nature.

Green finance offers notable advantages but also faces important challenges. On the benefits side, Sachs et al. (2019) highlights its significant economic contributions, noting that it integrates economic activity with sustainable development goals. While there is no universal model for transitioning to a green economy (Krahnen et al., 2021), traditional growth theories suggest that income generation drives industrial and trade expansion, while competition and profit motivate performance (Batrancea et al., 2021). In this context, a green economy encourages innovation and efficiency, particularly in renewable energy (Vesna, 2023), helping to reduce pressure on conventional resources.

Sustainable investment can also generate jobs, foster growth, and deliver long-term savings. For example, investment in renewable energy reduces the consumption of fossil fuels, resulting in energy price stability (Idris et al., 2023). ESG analysis also enables investors to evaluate firms' environmental, social, and governance policies, guiding sustainable investment decisions (OECD, 2022). Furthermore, resource allocation to environmentally friendly activities promote sustainable trade and investment (Ozili, 2022). Green finance also supports the development of smart cities, mitigating carbon emissions in both the short and long terms (Li et al., 2021).

Green finance also has drawbacks. Berensmann & Lindenberg (2016) mention barriers such as the difficulty of internalizing environmental externalities, information asymmetry, and ambiguous definitions of what "green finance" is. Other researchers cite barriers such as short-term investment horizons, policy incoherence between financial and environmental realms, and insufficient government support for the transition (Falcone & Sica, 2019). It is also hard to measure the "greenness" of companies and somewhat subjective, since there are various perceptions of the notion (Gilchrist et al., n.d.). In lower- and middle-income countries, underdeveloped markets create further institutional, financial, and policy barriers (Otek Ntsama et al., 2021). Finally, Schletz et al. (2020) argue that high transaction costs associated with certification and monitoring are to blame for the slow pace of scaling up green investment.

The Concepts of Green Finance

With time, several terms and definitions have been proposed to conceptualize green finance. Zhang et al. (2019) noted that it has gained ever-growing attention from finance practitioners, policymakers, and scholars due to its profound implications on economic life. However, as Feng et al. (2023) point out, the term has differing meanings to different stakeholders – academics, policymakers, firms, and practitioners – and therefore it is difficult to come up with a consensus definition. Such a lack of unified definition is also put forward by Hohne et al. (2012), Zadek and Flynn (2013), Dorry and Schulz (2018), and Volz et al. (2015).

Hohne et al. (2012) define green finance as a broad concept encompassing financial investment in sustainable projects, environmentally friendly products, and policies supporting an economy that is sustainable. This includes but is not limited to climate finance, stretching to areas such as industrial pollution control, water management, and biodiversity protection. Bahl (2012) also defines it as financing activities, technologies, and projects that reduce pollution on an environmentally sustainable basis. Zadek & Flynn (2013) identify that while the term has been used synonymously with 'green investment', green finance involves a wider scope as it involves operating and preparation costs such as purchasing land.

Other authors provide more precise definitions. Lindenberg (2014) calls it financing public and private green investments, while Volz et al. (2015) focus on investment and lending practices that consider the environmental impacts and optimize sustainability, especially highlighting the aspect of environmental risk screening in banking and investment procedures. Wang & Zhi (2016) define it as the integration of environmental protection and economic benefit.

Later work broadens the concept even further. Laskowska (2018) correlates green finance with ecohumanism, emphasizing cooperation for the benefit of society, future generations, and the environment. Mohd & Kaushal (2018) position it as green development money for reducing emissions and air pollutants in furtherance of Höhne et al.'s earlier definitions. Narayanan (2020) emphasizes its role as a vehicle financial activity connecting environment, finance, and investment. Qin et al. (2022) states it as economic activities with a view to environmental improvement, climate resilience, and the efficient use of resources, while Ozili (2022) states it as a new source of funding for low-carbon activities. Mishra and Kannaujia (2023) point out a lack of strict definition but view green finance quite holistically as financing support for sustainability activities like renewable energy, waste management, ecosystem conservation, and green infrastructure.

In brief, green finance can be most aptly defined as a portfolio of financial actions that offer economic profitability combined with environmental and sustainability objectives. It covers funding green technology and investments, pollution reduction measures, and resource efficiency solutions. Importantly, it encompasses not only direct investment but also associated expenses such as preparation work and land acquisition. By linking capital flows with environmental objectives, green finance is a primary enabler of financing for renewable energy, sustainable urbanization, waste management, and biodiversity conservation.

Dimensions of Green Finance

Green finance encompasses financial activities that directly support environmental sustainability objectives. In simple terms, it refers to loans or investments that fund environmentally friendly initiatives such as the purchase of green goods and services or the development of green infrastructure. Public awareness of this financing model has grown significantly, with banks increasingly offering accessible green products to support sustainable projects (Wire, 2024). Within the Visegrad Four, central banks – including Česká národní banka, Magyar Nemzeti Bank, Narodowy Bank Polski, and Národná banka Slovenska – play a crucial role in shaping their domestic green finance markets, particularly as regulators reducing information asymmetries (Shipalana, 2020).

Mohd & Kaushal (2018) describe green finance in terms of “green credit,” where banks and financial institutions are required to invest in pollution control, ecological protection, and restoration measures (Xu, 2013). This has encouraged stock market investors to prioritize environmentally compliant industries (Heim & Zenklusen, 2005). The rise of green finance has also prompted the revision of accounting and reporting standards, with uniform indicators being developed to quantify sustainability.

Green finance spans a wide range of initiatives by public and private banks, international organizations, and businesses to support long-term sustainability (Narayanan, 2020). It includes financial instruments such as green loans and bonds, strategies for managing environmental and climate risks, sector-specific investments, industry-led initiatives, and regulatory frameworks (Siemionek-Ruskań & Fanea-Ivanovici, 2023).

Many countries have also established dedicated green funds to finance green economy projects. A notable development in this area is the rise of ethical banks, which operate according to sustainability principles and channel resources exclusively into ethical projects. Such banks align socially responsible lenders with borrowers, reducing agency-related inefficiencies and enhancing social welfare (Barigozzi & Tedeschi, 2015). Though more common in developed economies, ethical banks exemplify the broader trend of integrating values into finance. The most recognized forms of green finance include green bonds, sustainability-linked loans, green lending, green equity investments, and green mortgage bonds. These instruments are designed to support climate protection, energy efficiency, and the sustainable use of natural resources (OECD, 2021).

Green Lending

Banks are playing a growing role in green lending. Loans provided under green credit lines are generally subject to strict technical eligibility criteria. In most cases, this requires predefined lists of technologies or products that qualify as 'green' without the need for additional evaluation. To support consistency, several multilateral development banks, together with the International Development Finance Club (IDFC), have established MDB-IDFC Common Principles for tracking mitigation finance. These principles include a sectoral classification system that identifies which areas are eligible for mitigation-related funding (European Commission, 2017).

Green Bonds

Since the 2010s, the global market for green bonds has expanded rapidly (Wang & Zhia, 2016). These are fixed-income securities used to finance environmentally beneficial investments. Unlike conventional bonds, their proceeds are earmarked exclusively for green projects, with the issuer – or in some cases a third party – committing to this allocation. Although no universal definition exists, the International Capital Market Association (ICMA, 2021) defines green bonds as instruments whose proceeds are dedicated to financing or refinancing, fully or partially, new or existing green projects, in line with the four components of the Green Bond Principles (Roncalli, 2025). Green bonds are particularly relevant for supporting clean energy development (Sachs et al., 2019).

The environmental credibility of green bonds is often validated through external reviews, known as "second opinions," which assess compliance with the Green Bond Principles and evaluate the expected environmental impact of funded projects (European Commission, 2017). Between 2014 and 2021, most issuances were concentrated in sectors such as energy and transport (Siemionek-Ruskań & Fanea-Ivanovici, 2023). As Sobik (2023) notes, green bonds play a central role in financing energy supply, while Hadaś-Dyduch et al. (2022) emphasize their broader function as fixed-income securities that channel capital into projects with positive environmental outcomes.

Green Equity Investing

Investors are increasingly adopting diverse strategies to pursue sustainable investments. Green equity investments typically take the form of equity funds or leveraged investments. In recent years, specialized indices have been created to track the performance of green industries, companies, and assets. While index providers are generally transparent about the criteria used to select "green" companies, the methodologies applied by green equity funds are often more complex and, at times, contested. To address these concerns, various labels and certification schemes have been introduced to verify and standardize the green credentials of such funds (European Commission, 2017).

From a global perspective, interest in environmental protection is rising, particularly within the banking sector. This is expected, given the undeniable impact of human economic activity on nature. The trend also has a financial dimension, reflected in the growth of green financial instruments and the broader adoption of corporate social responsibility (CSR) principles (Laskowska, 2018). Over the past decade, attention to sustainability, sustainable development, and green finance has grown markedly (Hall & Meng, 2024).

In broad terms, green finance refers to financial activities and investments designed to deliver positive environmental outcomes. It extends beyond climate change mitigation to include the preservation of biodiversity, social inclusion in lending, and promotion of low-carbon technologies, industries, and businesses (Ntambirweki et al., 2022). Green finance is leading the charge towards sustainable development as well as the

achievement of the SDGs. In their bid to achieve net-zero emissions, fiscal, monetary, and regulatory policies must be set at both national and local levels. Among the immediate priorities is provision of affordable green finance to micro, small, and medium-sized enterprises (SMEs) to open up access for them to banks and institutional finance. Common areas of green finance include renewable energy, energy efficiency, pollution control, biodiversity conservation, circular economic initiatives, and the sustainable use of natural resources and land.

Connecting Green Finance, the EU Green Deal, and Taxonomy

Green finance is increasingly becoming a key strategic policy agenda for the European Union, complementing its broader agenda for sustainability. EU Green Deal and EU Taxonomy Regulation are two such tools in this effort. The European Green Deal aims to position Europe as the world's first carbon-neutral continent by 2050 (European Commission, 2019). Achieving this objective must entail the most intimate possible cooperation among financial markets, companies, and public authorities, with the Taxonomy Regulation establishing the common framework for the identification and regulation of sustainable activities. The Green Deal is not only an environmental but also an economic and financial revolution backed by at least €1 trillion of sustainable investment between 2020 and 2030 in the Sustainable Europe Investment Plan (European Commission, 2020). Financing will be secured through the European Investment Bank (EIB), development banks, and private sources of capital, with green finance as the motivation for this change.

Regulation (EU) 2020/852 – the EU Taxonomy Regulation – establishes one set of classifications to identify environmentally sustainable economic activity and prevent greenwashing. It requires that activities promote at least one of six environmental objectives in order to be labeled sustainable:

- Climate change mitigation: e.g., renewable energy, energy efficiency.
- Climate change adaptation: enhancing resilience of societies and ecosystems.
- Sustainable use of water and marine resources: preventing pollution and protecting water systems.
- Circular economy: promoting recycling, reuse, and waste reduction.
- Pollution prevention and control: reducing or eliminating harmful emissions.
- Biodiversity and ecosystem protection: conserving ecosystems and natural habitats.

The Regulation also obliges large companies and financial service providers to report how their activities align with taxonomy criteria, increasing transparency and guiding investors toward genuinely sustainable projects (European Parliament & Council, 2020). This structure creates new responsibilities on financial institutions to integrate ESG factors into lending and investment decisions. While this shift is difficult – for instance, added administrative burdens and the need to collect data – ultimately, it makes Europe more competitive and facilitates a low-carbon sustainable economy.

The Role of Green Finance in the V4

The Visegrad Four (V4) nations have profound economic, historical, and cultural affinities based on a shared civilisation informed by both past and present social habits (Brokešová & Vachálková, 2016). From the Visegrad summit during Charles Robert's time to the present, the area has followed strategic collaboration to deepen its role in business and politics (Arday, 2015). Following the changes of regimes in the late 20th century, all four countries went through profound changes, such as industrial restructuring enabling emission reduction with regard to the Kyoto Protocol (Karásek & Pavlica, 2016; Káposzta & Nagy, 2015).

Despite this shared past, the V4 countries are approaching the green transition at different speeds and by means of different strategies. The EU Green Deal sets a collective target of climate neutrality by 2050 (European Commission, 2020), yet national actions and policies diverge significantly. Common challenges stem from their heavy reliance on fossil fuels – particularly coal – as well as regulatory frameworks that are often fragmented or insufficiently aligned with EU standards. The OECD (2023) highlights major differences across V4 in adopting ESG principles into national law and developing environmental tax policies. Private sector engagement also remains limited, as companies are often unaware of the benefits of green finance or reluctance to invest in long-term sustainability. Compared to regional pioneers such as Austria, the V4 lags in technological leadership in climate and environmental innovation (Grzegorczyk, 2023).

Within this context, the green bond market is particularly important for V4. Its development matters not only as a policy tool but also in practice – shaping opportunities for issuers, institutional and individual investors, businesses, and national economies alike (Hadaś-Dyduch et al., 2022).

Czech Republic – Strong Regulation, Slow Implementation

In recent years, sustainability has gained increasing global importance, particularly in light of accelerating climate change, biodiversity loss, shrinking water resources, rising waste volumes, and air and water pollution. Addressing these challenges requires an accelerated economic transformation in which the banking sector plays a pivotal role (Arora et al., 2018).

The Czech Republic is currently prioritising the development of a regulatory framework for sustainability. In 2021, the government adopted the National Energy and Climate Plan, which outlines the long-term ambition of achieving a climate-neutral economy by 2050. However, implementation remains at an early stage, with only limited green financing instruments identified to date. The domestic banking sector is still becoming familiar with the concept of green finance. While institutions such as ČSOB and Komerční banka have introduced green loan products, their market share remains marginal. Moreover, the Czech National Bank does not yet have an explicit green mandate, meaning that most incentives are market-driven rather than regulator-driven (OECD, 2023). These challenges are further complicated by low levels of public awareness and limited information dissemination.

In practice, sustainable finance in the Czech Republic is reflected mainly in sectoral legislation, such as laws governing investment companies and investment funds (Jurkowska-Zeidler & Schweigl, 2023). However, these provisions typically fall under the broader umbrella of ESG (environmental, social, and governance) criteria and are not specifically targeted at green financing products. A notable development occurred on 24 May 2023, when ČSOB issued its first green bond for private banking clients, valued at CZK 1,000,000,000. Under ČSOB's Green Bond Framework (2022), the proceeds must be allocated exclusively to eligible projects defined within the framework. For the first Allocation and Impact Assessment, the reporting period covered 1 January 2020 to 30 April 2024. By the closing date of 30 April 2024, 100% of the proceeds had been used to refinance existing projects initiated before the bond issuance. All funds were directed towards green buildings, fully meeting the framework's technical and environmental criteria (ČSOB, 2024).

Hungary – Regulation-Driven Approach Led by the Central Bank

After 2019, the Hungarian corporate bond market began to expand at a rapid pace, coinciding with growing demand for sustainable financial products. Although the Hungarian National Bank (Magyar Nemzeti Bank – MNB) did not initially set an explicit green target when launching its green programme, it nevertheless played a pivotal role in fostering the development of a dedicated green corporate bond segment. The defining feature of green bonds, in contrast to conventional bonds, is that their proceeds are earmarked exclusively for investments with clear and measurable environmental or climate-related benefits, whether direct or indirect (MNB, 2024).

In Hungary, the MNB has become the central driving force behind the creation of a green financial system. In 2019, it introduced the Green Programme, which set out to integrate ESG considerations into the domestic financial sector, create a functioning market for green mortgage bonds, encourage sustainable lending practices, and address risks associated with climate change and environmental degradation (MNB, 2020). Hungary stands out in the region as one of the few countries where the central bank not only goes green by encouraging greening efforts through the commercial banking system but also in its own portfolio. Under this program, the MNB has taken a chain of actions to enhance the environmental awareness of Hungarian banks and to encourage them to develop ecologically aware products. Notably, the MNB itself issued its own green bond in 2021 and introduced preferential capital requirements for banks involved in green lending (OECD, 2023).

Hungarian green bond issuance constitutes explicit support for Hungary's commitments under international climate agreements. Proceeds are allocated to six eligible categories of green expenditure: renewable energy, energy efficiency, sustainable land use and natural resources, wastewater, clean transport, and climate adaptation (MNB, 2022). Competent financing in the mentioned sectors is of key importance to the development of a green economy and environmental sustainability. The first domestic green corporate bond was issued under the Bond Funding for Growth Scheme (BFGS) by CPI Hungary Investments Kft, marking the start of dynamic growth of the Hungarian green bond market. Between 2020 and the present, 133 corporate bond

issues were made, of which 24 were green. The sectoral division of these issuances has been diverse, and the majority have been in real estate, electricity, gas, and air conditioning industries (MNB, 2024).

A notable progress for Hungary, and for the Visegrad region more generally, has been the European Union Council's approval of the European Green Bond Regulation. This framework is intended to direct capital towards environmentally friendly projects and to accelerate the way towards a climate-neutral economy. Since it will improve comparability of green bonds and reduce greenwashing risk, regulation should also increase investor confidence in sustainable securities (Horváth, 2020). In line with these developments, Hungary updated its Green Bond Framework in July 2023 such that future reopenings or issues of green bonds would address developing European regulatory standards, international best practice, and increasing investor expectations (MNB, 2024).

Green mortgage bonds have also gained attention in Hungary's sustainable finance market in recent years. The instruments obligate mortgage banks to maintain loan portfolios with the same number or more green – energy-efficient – properties than the value of funds raised by issuing the mortgage bonds. The mortgage bonds, hence, provide improved-quality collateral to bondholders that meets environmental sustainability targets as well as broader socio-economic policy goals. Rising demand for such securities could incentivize banks to expand green mortgage lending, ultimately lowering credit risk, improving pricing conditions, and potentially reducing lending rates.

Poland – An Early Leader in Green Bond Issuance

The financial challenges of mitigating and adapting to climate change constitute a central element of global strategies aimed at achieving sustainability. Climate instability, the increasing frequency of natural disasters, and the growing risks associated with climate change affect entire economies, demanding the implementation of adequate and innovative measures (Więckowska, 2013). The energy transition, the pursuit of ESG targets, and investments in renewable energy sources all necessitate the development of new financing approaches (Sobik, 2023).

Green banking products are seen as the future of modern banking. Wishing to utilize technological advancements, the majority of Polish banks begin to offer green services while at the same time promoting green lifestyles and greater care for the world. The banking sector in Poland follows European green bank policy and innovative implementation of green finance (Zioło et al., 2018). The most important asset in this respect is the Green Finance Reports (Zielone Finanse w Polsce), published under the coordination of Komisja Nadzoru Finansowego (KNF). The reports reflect the state of green finance in Poland, present existing trends, analyze changes, identify major challenges, and outline future possibilities (Związek Banków Polskich, 2022; Bukowski et al., 2019).

Poland positioned itself as a pioneer in green finance in 2016 when it launched the world's first sovereign green bond – a groundbreaking and huge success in its financial sector. The issue advertised Poland's government's commitment to green projects and, at the same time, national environmental goals. Within the system, the Treasury of the Republic of Poland shall report annually – within one year from issue and up to the date of their full subscription – on the use of green bond proceeds to ensure accountability and transparency (Ministry of Finance, Republic of Poland, 2021).

By taking these actions, Poland is contributing not only to its own greenhouse gas emission-reduction targets but to the European Union's as well, moving closer to achieving the Sustainable Development Goals (SDGs). The Polish Green Bond Framework specifies the eligible sectors for bond proceeds, including:

- Sustainable agricultural activities.
- Clean transport.
- Renewable energy.
- National parks and reforestation.
- Landfill reclamation.

These categories clearly correspond to the objectives of the SDGs (Bąk et al., 2023). To ensure maximum transparency, the framework also lists specific project types explicitly excluded from financing, such as electricity generation from fossil fuel combustion.

Within the commercial banking sector, mBank was the first institution in Poland to sign the Responsible Banking Principles, which support both the Paris Climate Agreement and the SDGs. mBank also became the first commercial bank to issue green bonds, valued at PLN 500 million, and currently offers three key green products: green mortgages, green payment cards, and photovoltaic leasing solutions (mBank, 2022). Similarly, Santander Bank Polska had issued green, social, and sustainability bonds worth PLN 750 million by the end of 2021. In July of the same year, it introduced its first green card, aimed at reducing the institution's carbon footprint (Siemionek-Ruskań & Fanea-Ivanovici, 2023).

The ING Group has also been active in green bond issuance. ING Bank Śląski issued its first green covered bond in 2019, raising PLN 400 million. It now offers individual eco-loans and eco-mortgages. Eco-loans can finance the purchase of renewable energy technologies such as solar and photovoltaic systems, heat pumps, boilers, collectors, and energy-efficient heating or electrical equipment, as well as electric and plug-in hybrid vehicles. Eco-mortgages support the purchase of energy-efficient homes (ING Bank Śląski, n.d.).

For Poland, green bonds are a cornerstone of financing the energy transition, which is particularly critical given the country's heavy dependence on coal and the urgent need to decarbonise and transform the electricity generation sector. The examples above highlight the significant contribution of the Polish banking sector to the growth of the green bond market and to the broader green transition (Sobik, 2023).

Slovakia – Financing Model Anchored in EU Funds

The Slovak financial market is dominated by a large and influential banking sector, which accounts for approximately 70% of the total assets of the country's financial system (Kalman et al., 2023). In addition to intra-group financing provided to subsidiaries of multinational companies, the banking sector remains the principal source of funding for Slovak corporates. By contrast, the regulated equity market, represented by the Bratislava Stock Exchange, has shown almost no viability in terms of equity financing. However, the bond market has experienced dynamic growth over the past two decades, gradually becoming a more important channel for raising capital (Mazúr & Petrovičová, 2024). Slovakia's progress towards a green transition is largely dependent on European Union support. Renewable energy, particularly solar and biomass, features prominently in the national energy strategy, yet the domestic green financial market remains underdeveloped (OECD, 2023). The issuance of green bonds is still very limited, and Slovak banks offer few, if any, specialized green financial products.

Table 1. V4 green financing achievements

Country	Outstanding instruments/programmes	Challenges	The role of the public sector	Private sector activity
Poland	Sovereign green bond, transport projects	Fossil dependence, carbon-based energy	Strong public involvement	Growing, but sector-dependent
Hungary	MNB Green Programme, green mortgage bonds	Lack of information, technology costs	Strong central bank governance	Limited, developing
Slovakia	EU projects, local government initiatives	Regulatory gaps, market underdevelopment	Relying on EU funds	Low, rudimentary
Czech Republic	National Energy and Climate Plan, bank green loans	Slow implementation, lack of information	Regulatory foundation	Marginal

In 2021, Slovakia adopted its first climate finance strategy, marking an important step in policy development. Nonetheless, implementation has been slow. According to the IMF Country Report (2022), inefficiencies in the allocation of budgetary resources persist, and the country still lacks a comprehensive regulatory framework that would create stronger incentives for private investment in sustainable projects. At the same time, there are positive examples at the municipal level: cities such as Bratislava have taken the lead in promoting green urban mobility and improving energy efficiency. Several projects—such as the electrification of public transport systems and the energy-efficient renovation of schools—have received support from the European Investment Bank (EIB).

In the context of the Visegrad Four, Slovakia illustrates one of several diverse approaches to integrating green finance into national financial systems. While its model is primarily reliant on EU funds and external support mechanisms, each of the four countries has pursued different pathways to embedding green finance within their financial and economic structures. This comparison is reflected in Table 1, which summarises the key findings on green financing across the V4.

In case of Poland and Hungary, the central bank plays a very important role in green financing, while Slovakia and the Czech Republic focus on something completely different than EU funds. In terms of challenges, slow implementation and informality come to the fore. As for the private sector, the authors of this study found big differences.

Conclusions

At present, structured cooperation in green finance among the Visegrad Four (V4) remains limited. Nevertheless, the region shares common institutional foundations and interests that could serve as a basis for building joint green platforms. In the 21st century, green finance has become an essential tool for sustainable economic development, particularly in the context of global efforts to combat climate change and promote environmental sustainability. While the V4 countries are advancing at different levels and speeds in the green finance transition, they face a set of shared challenges.

Knowledge about the V4 green bond market remains scarce, with limited country-specific information available in the literature. Within the group, Poland has positioned itself as a pioneer, having issued the world's first sovereign green bond in 2016 and subsequently expanding its range of green banking products. Leading financial institutions such as mBank, ING Bank Śląski, and Santander Bank Polska have actively contributed to developing the domestic green bond market. In Hungary, the advancement of green finance has been strongly regulation-driven, with the Magyar Nemzeti Bank (MNB) introducing programmes that promote green mortgage bonds, preferential capital requirements, and incentives for corporate green bond issuance.

The development of green finance in the Czech Republic has been more gradual and modest. Initiatives such as ČSOB's green bond issuance demonstrate progress, but the broader regulatory framework is still under development, and ESG integration remains at an early stage. Importantly, the Czech National Bank has yet to assume an active role in driving the transition. In Slovakia, the green financial system relies heavily on EU funds and support mechanisms, with gradual integration of green elements into financial systems occurring mainly through legal harmonisation obligations.

The effectiveness of green finance depends heavily on the degree of public–private cooperation. Within the V4, this cooperation varies across countries but remains critical everywhere. The public sector's role includes creating the appropriate regulatory environment to stimulate green investment—through legislation that supports green bond issuance, the introduction of tax incentives, and sustainable public procurement practices that integrate ESG principles. The public sector also plays an essential role in awareness-raising, helping mobilise private investment. Meanwhile, the private sector – particularly banks, investment funds, and corporations – serves as the primary channel for distributing capital market instruments. Notably, the growth of green bonds and loans is closely correlated with companies' ESG ratings, underlining the importance of transparent reporting and governance.

Looking ahead, one potential area for deeper cooperation is the establishment of a joint V4 Green Bond Fund, which could provide municipalities, SMEs, and NGOs with easier and more cost-effective access to sustainable finance. Another promising initiative would be the creation of joint education programmes aimed at financial sector stakeholders, raising awareness of ESG and building capacity. The Central European region also offers strong potential for localising green technologies, deploying decentralised renewable energy sources, and scaling up energy-efficient building renovation. Maximising the use of EU support mechanisms – such as the EU Taxonomy and the European Green Deal – while fostering coherent, transparent, and incentive-based national regulatory environments will be key to success.

In conclusion, the V4 countries have all made notable progress in establishing green finance, though the maturity and depth of their financial markets vary considerably. Future progress will depend on strengthening regional cooperation, enhancing transparency, educating financial institutions, and reinforcing commitment to sustainability objectives. If effectively implemented, the green transition will bring substantial long-term

benefits, fostering not only environmental protection but also economic resilience and social well-being, and ultimately contributing to more competitive and climate-smart economies across the Visegrad region.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

Conflict of Interest

* The authors declare that they have no conflicts of interest

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