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The Impact of Financial Mechanisms for Sustainable Development on the Evolution of Global Value Chains

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ABSTRACT. The article examines the development of international climate policy and the role of the Conference of the Parties (COP) in shaping the current architecture of sustainable financing and green transformation of global supply chains. It highlights the key decisions of COP21–COP30, which defined the parameters of global commitments to mitigate the effects of climate change, mobilise financing for developing countries, and implement low-carbon development mechanisms. The main financial instruments of the modern sustainable development system (such as green bonds, sustainability-linked bonds, ESG investing, climate funds, and programmes of international financial organisations) are outlined, and their connection to the achievement of the Sustainable Development Goals is analysed. Attention is paid to the transformation of the strategies of banks and institutional investors, which, by integrating environmental criteria into risk assessment and decision-making processes, are becoming key catalysts for the transition to more sustainable models of production and logistics. The paper analyses the dynamics of global greenhouse gas emissions by region and country group according to income level, which has made it possible to identify uneven climate progress and differences in the impact of regulatory incentives on development trajectories. It is shown that the transformation of global value chains after COP21 is determined by a combination of regulatory, market and technological factors: stricter environmental requirements (in particular, CBAM, requirements for reporting greenhouse gas emissions (Scopes 1–3) and environmental, social and corporate governance results), growing expectations of consumers, shareholders and a wider range of stakeholders regarding sustainability, the emergence of new competitive models (recycle, upcycle), as well as the

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need to increase energy and resource efficiency and modernise production and logistics in conditions of limited natural capital, competition for access to financial resources at reduced rates. Particular attention is paid to analysing the current state of development of sustainable financing instruments in Ukraine. Examples of successful cases of integrating green instruments into the corporate and banking sectors are provided, the role of international technical assistance is emphasised, and key barriers are identified: insufficient standardisation, limited access to capital and high transaction costs. It is concluded that the success of the environmental transformation of global value chains is determined by the synergy between states, international organisations, financial institutions and the private sector. At the same time, in the current context of geopolitical and macro-financial instability, market incentives, such as the need to improve efficiency, sustainability and competitiveness, are becoming dominant factors in the integration of sustainable development practices into supply chains.
KEYWORDS: global economy, global supply chains, Industry 4.0, international conventions, regulation, ESG, digitalisation, finance, international settlements, fintech, green loans, green bonds.

Introduction

The search for ways to combine economic growth with environmental stability has defined the global agenda in recent decades. In this context, financial mechanisms for sustainable development have become one of the key instruments capable of directing capital flows towards green technologies, low-carbon energy and sustainable production practices. The gradual institutionalisation of these mechanisms, which began with the adoption of the Kyoto Protocol (1997) and became systematic after the Paris Agreement (2015), has had a significant impact on global value chains, transforming the structure of production, logistics and international trade.

The relevance of studying the evolution of global value chains in the context of the transformation processes launched by the Kyoto climate system is determined by the need for a deeper understanding of how climate policy and financial incentives shape new principles of competitiveness, the spatial organisation of production and cost distribution mechanisms in the global economy in conditions of growing instability. With the tightening of regulatory requirements for corporate reporting, the expansion of the green bond market, the development of sustainable investment taxonomies and the formation of international ESG standards, the financial architecture is becoming increasingly integrated with the global production system. Accordingly, analysing the relationship between sustainable development financial instruments and the evolution of global value chains can help not only to examine the effectiveness of current climate policy, but also to outline directions for the formation of a new paradigm of international economic integration based on the principles of sustainability, transparency and innovation.

Literature review

Research on the transformation of value chains (supply chains) in the context of sustainable finance is receiving increasing attention from scholars. It is worth noting studies related to the impact of international climate policy on the formation of the financial landscape. In particular, K. Guesmi et al.[4] examine the impact of the Paris Agreement, which established a global framework for mitigating the effects of climate change. L. Carlsen[5] notes that more recent conferences, such as COP29 in Baku (2024), have focused on financing climate action, as it is believed that wealthier countries should finance actions in poorer countries to address the effects of greenhouse gas emissions. At the same time, P. Mure et al.[6], focusing on the study of banks' "green" credit products, emphasise that the introduction of green credit products preceded the implementation of clear legislation to reduce risks such as "greenwashing," which indicates that purely financial motives are the basis for "green" proposals in banking portfolios.

There are empirical studies[7] that confirm that green financing can significantly contribute to the green transformation of the real sector of the economy, in particular by directing capital to environmentally friendly industries. According to research, the introduction of green financing mechanisms effectively reduces carbon emissions[8]. For example, in the field of agriculture, Z. Yang and W. Zhao[9] study the agro-industrial sector of the PRC and point out that the main function of sustainable financing is to reconcile liquidity optimisation with the fair distribution of added value within agricultural systems. The researchers empirically demonstrate that effective sustainable finance acts as a transformational function that enhances the ability of enterprises to withstand external shocks and disruptions. Rouan, L. et

[4] Guesmi, Khaled, Kamel Si Mohammed, and Sunil Tiwari. "Green Horizons: Enabling the Energy Transition through Climate Change Policies." *International Review of Economics & Finance 94*, (2024): 103409. https://doi.org/10.1016/j.iref.2024.103409.

[5] Carlsen, Lars. "The Baku Paradox: An Analysis of Selected Sustainable Development Goals." *Sustainability 17*, no. 6 (2024): 2547. https://doi.org/10.3390/su17062547.

[6] Murè, P., S. Giorgio, V. Antonelli, and L. Bittucci. "Environmental Credit Products: Where Do We Stand? A Response from an Academic Content Analysis." *The Quarterly Review of Economics and Finance 100*, (2025): 101955. https://doi.org/10.1016/j.qref.2024.101955

[7] Hua, Mingzhong, Zhe Li, Yudong Zhang, and Xiaobei Wei. "Does Green Finance Promote Green Transformation of the Real Economy?" *Research in International Business and Finance 67*, (2023): 102090. https://doi.org/10.1016/j.ribaf.2023.102090;

[8] Ren, Xuedi, Qinglong Shao, and Ruoyu Zhong. "Nexus between Green Finance, Non-fossil Energy Use, and Carbon Intensity: Empirical Evidence from China Based on a Vector Error Correction Model." *Journal of Cleaner Production 277*, (2020): 122844. https://doi.org/10.1016/j.jclepro.2020.122844

[9] Zhang, Yang, and Wei Zhao. "Examining Agricultural Firms' Risk-bearing Capability via Supply Chain Financing: Insights from China." *International Review of Economics & Finance 102*, (2025): 104282. https://doi.org/10.1016/j.iref.2025.104282

al.[10] and Sun, Y., and Xiong, D.[11] also show that green finance policies increase the resilience of supply chains.

K. Orchun and T. Orpishevski[12] point out that sustainable financing in the form of impact investing is a critical mechanism for achieving the UN Sustainable Development Goals. Such investments are aimed at creating measurable positive social or environmental outcomes alongside financial returns. According to this study, on average, companies focused on positive impact in the context of the SDGs attract more than twice as much funding, including equity financing. At the same time, investors prefer younger companies with potential for innovation and long-term impact that can provide greater transparency of information and operational stability, as this also reduces information asymmetries; companies located in developing countries are also more attractive than those in developed countries. In addition, it is highlighted that the agricultural sector has the highest attractiveness ratio for impact investors, while other priority sectors include financial services, education and healthcare.

In contrast, in the context of the asymmetry of economic development in the global economy, L. Karlsen[13], analysing the latest data from the 2024 Sustainability Report[14], points out that the available empirical data does not indicate that the growth of innovative activity in developed countries is accompanied by an increase in the level of sustainability of production or consumption, or by greater climate responsibility.

A number of authors also focus on other sectoral aspects of the impact of sustainable finance. Considerable attention is paid to various aspects of sustainable energy transformation. For example, S. Knut[15] notes that the issue of rethinking energy infrastructure for the 21st century and ensuring a clean energy transition is creating conflict between competing economic doctrines, and in the United States in particular, this conflict is unfolding between proponents of technological breakthroughs and advocates of large-scale deployment of existing technologies. Analysing the impact of climate finance on the resilience of energy infrastructure in 74 developing countries, G. Nyanzang

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[10] Ruan, L., Yang, L., & Li, D. “The impact of green finance policies on supply chain resilience.” *Economic Analysis and Policy*, 87, 18-37, (2025). https://doi.org/10.1016/j.eap.2025.05.060

[11] Sun, Y., & Xiong, D. “Supply chain finance and enterprise resilience: From the perspectives of resource integration and organisational governance.” *Economics Letters*, 254, (2025): 112487. https://doi.org/10.1016/j.econlet.2025.112487

[12] Kaya, Orçun, and Tomasz Orpiszewski. "Determinants of Impact Investments: Evidence from Portfolio-level Data." *Journal of Sustainable Finance and Accounting 6*, (2025): 100018. https://doi.org/10.1016/j.josfa.2025.100018.

[13] Carlsen, Lars. "The Baku Paradox: An Analysis of Selected Sustainable Development Goals." *Sustainability 17*, no. 6 (2024): 2547. https://doi.org/10.3390/su17062547.

[14] Sustainable Development Report 2024. Dashboard. Available online: https://dashboards.sdgindex.org/explorer

[15] Knuth, Sarah. "“Breakthroughs” for a Green Economy? Financialisation and Clean Energy Transition." *Energy Research & Social Science 41*, (2018): 220-229. https://doi.org/10.1016/j.erss.2018.04.024

et al.[16] note a significant reduction in energy vulnerability in developing countries thanks to the financing of climate change mitigation measures, with mitigation finance having a more pronounced effect on reducing energy vulnerability than finance for adaptation to the effects of climate change.

In terms of investment attractiveness, M. Cortez et al.[17] examine European stocks over the period 2008-2020 and argue that in the energy sector, a green energy portfolio outperforms its "non-green" counterpart, but the better performance of the green portfolio is mainly due to improvements in performance and operational efficiency in recent years, and over the period studied, investments in green energy companies show almost the same good results as their "non-green" counterparts, which generally correlates with the conclusions of L. Carlsen[18].

In this regard, it is important to note the research on the impact of supply chain financing on increasing its sustainability. Research by M. Zheng et al.[19] shows that the introduction of trade finance instruments and, more broadly, supply chain financing, contributes to increasing the sustainability of companies by improving liquidity management and operational efficiency. At the same time, it is noted that the effectiveness of this mechanism depends on the type of ownership and market dynamics: state-owned enterprises demonstrate slower adaptation due to preferential resource allocation, while non-state-owned and more competitive companies derive more significant benefits from supply chain financing.

In the financial services sector, as T. Puchman and D. Quattrochi emphasise[20], one of the biggest methodological challenges associated with sustainable finance is accurately measuring environmental performance, particularly Scope 3 GHG emissions. Scope 3 emissions are the most significant (on average 84 per cent of a company's total emissions), but they are difficult to calculate and report because they occur outside the company, require intensive data exchange between stakeholders, and are part of global value chains. To overcome these challenges, the use of digital data infrastructure and financial technologies (so-called fintech) is proposed. Fintech significantly improves the development of green lending. Digital

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[16] Njangang, Henri, Hemachandra Padhan, and Aviral K. Tiwari. "From Aid to Resilience: Assessing the Impact of Climate Finance on Energy Vulnerability in Developing Countries." *Energy Economics 134*, (2024): 107595. https://doi.org/10.1016/j.eneco.2024.107595.

[17] Cortez, Maria C., Nuno Andrade, and Florinda Silva. "The Environmental and Financial Performance of Green Energy Investments: European Evidence." *Ecological Economics 197*, (2022): 107427. https://doi.org/10.1016/j.ecolecon.2022.107427.

[18] Carlsen, Lars. "The Baku Paradox: An Analysis of Selected Sustainable Development Goals." *Sustainability 17*, no. 6 (2024): 2547. https://doi.org/10.3390/su17062547.

[19] Zheng, Mengze, Rui Wang, Jing Ye, and Te Li. "How Does Supply Chain Finance Enhance Firms' Supply Chain Resilience?" *International Review of Economics & Finance 102*, (2025): 104231. https://doi.org/10.1016/j.iref.2025.104231.

[20] Puschmann, Thomas, and Dario Quattrocchi. "Decreasing the Impact of Climate Change in Value Chains by Leveraging Sustainable Finance." *Journal of Cleaner Production 429*, (2023): 139575. https://doi.org/10.1016/j.jclepro.2023.139575

infrastructures that combine different measurement methods, integrate cross-chain data, and combine primary and secondary data can improve the accessibility, reliability, and accuracy of Scope 3 emissions reporting. In particular, technologies such as blockchain, artificial intelligence (AI) and the Internet of Things (IoT) can increase the availability and reliability of data and facilitate the integration of value chain data.

Analysis of sources shows that green finance and sustainability in supply chains is a rapidly growing and critically important area of research. Central to this is the role of financial innovation (fintech, green loans, sustainability-linked loans) in accelerating the energy transition, balancing the need for technological breakthroughs with the large-scale deployment of existing technologies. Key challenges remain the standardisation of ESG data (especially for Scope 3 emissions), overcoming the risk of greenwashing and ensuring transparency in the absence of clear regulation, which necessitates further research to develop more sophisticated methodologies for real-time data aggregation and integration, leveraging the potential of advanced digital technologies. In this context, *the aim* of this article to highlight the relationship between the development of sustainable finance and contemporary transformations in global value chains becomes particularly relevant. Further research is also worthwhile on the development of theoretical models of the impact of financing on value chains.

The emergence of international climate policy and the role of the Conference of the Parties (COP)

By 2015, when COP21 was held in Paris, international climate policy had undergone a complex process of forming a legal framework, financial mechanisms and political readiness of the global community for collective action. The basis for this policy was the United Nations Framework Convention on Climate Change (UNFCCC, 1992, Rio de Janeiro)[21], which laid down the principles of common but differentiated responsibilities of countries and created a platform for further international agreements. One of the first key steps was the adoption of the Kyoto Protocol at COP3 (1997, Kyoto), which set legally binding targets for greenhouse gas emission reductions for developed countries, while the Marrakesh Accords (COP7, 2001) detailed the rules for its implementation.

However, the limited scope of the Kyoto Protocol and the need to involve developing countries created a need for new mechanisms. Thus, COP13 in Bali (2007) initiated negotiations on a global post-Kyoto agreement, and COP15 in Copenhagen (2009) attempted to adopt a comprehensive agreement, resulting in the Copenhagen Accord with the aim of limiting global warming

[21] *United Nations Framework Convention on Climate Change,* https://zakon.rada.gov.ua/laws/show/995_044#Text.

to 2°C and the beginning of promises of financial assistance to developing countries. COP16–COP20 (Cancun, Durban, Warsaw, Lima; 2010–2014) laid the foundations for transparency mechanisms and nationally determined contributions (NDCs), and formalised financial instruments such as the Green Climate Fund (Table 1).

Table 1

KEY OUTCOMES OF COP1*–COP20: THE FORMATION OF THE KYOTO CLIMATE SYSTEM

COP No.	Year, venue	Key decisions/significance	Conditional stage
COP	1995, Berlin	Start of negotiations on emission reduction commitments.	Early agreements — creation of the first commitment system
COP3	1997, Kyoto	The Kyoto Protocol was adopted — the first international agreement that obliged developed countries to reduce greenhouse gas emissions (by an average of 5% from 1990 levels).	
COP7	2001, Marrakesh	The Marrakesh Accords, which detailed the rules for implementing the Kyoto Protocol.	
COP11 /CMP1	2005, Montreal	The Kyoto Protocol entered into force; discussions began on a new agreement for the period after 2012.	Kyoto era — limited commitments for developed countries
COP13	2007, Bali	The Bali Action Plan was adopted, initiating negotiations on a new global agreement after Kyoto.	
COP15	2009, Copenhagen	Attempts to adopt a comprehensive agreement failed, but the Copenhagen Accord was reached: the goal of limiting global warming to 2°C was recognised, and the formation of a financing mechanism for developing countries was initiated (a pledge of USD 100 billion per year).	
COP16	2010, Cancun	The Copenhagen decision was formalised in the form of the Cancun Agreements: the Green Climate Fund was established, the goal of limiting global warming to 2°C was confirmed, and the importance *of adaptation, not just emission reductions*, was recognised.	Prerequisites for the Paris Agreement — movement towards a global agreement with the participation of all countries
COP17	2011, Durban	The Durban Platform was launched, where it was agreed to develop a new comprehensive agreement by 2015 (in fact, this became the 2015 Paris Agreement).	
COP19	2013, Warsaw	The Warsaw International Mechanism on Loss and Damage; a framework for nationally determined contributions (NDCs).	
COP20	2014, Lima	Agreement reached on key elements of the future Paris Agreement; countries began submitting their nationally determined contributions (NDCs).	

Source: summarised by the author based on[22].

* COP (conference of parties) — international meetings within the framework of the United Nations Framework Convention on Climate Change (UNFCCC). *(author's note)*

Thus, by COP21, global climate policy had gone through a stage of preparation for a global agreement: from fragmented protocols and political agreements to a structured system that allowed all countries to make collective commitments. The Paris Agreement (2015) was the culmination of this process, ushering in a new era of international cooperation on sustainable development.

The adoption of the Paris Agreement[23] in 2015 was a turning point in global climate policy, cementing the transition from declarative to systemic commitments by states and the private sector in the field of decarbonisation[24]. Its significance lies not only in setting a common goal of limiting global warming to 1.5–2°C, but also in creating a new financial architecture designed to mobilise capital flows towards sustainable development.

The period after COP21 (2015) was marked by the formation of a new global climate system, centred on the commitment to limit global temperature rise to 1.5–2°C and the introduction of nationally determined contributions (NDCs) as a tool for gradually raising climate ambitions (Table 2).

Table 2

COP21–COP30: CHRONOLOGY, VENUES AND KEY DECISIONS

COP No.	Year, venue	Key decisions/significance
COP21	2015, Paris, France	Adoption of the Paris Agreement. Creation of a global framework to limit global warming to 1.5–2°C; the beginning of a new era in climate policy.
COP22	2016, Marrakesh, Morocco	Adoption of the Marrakesh Partnership. Operationalisation of the Paris Agreement implementation processes; strengthening the participation of non-governmental actors.
COP23	2017, Bonn, Germany	Progress in the implementation of the Paris Agreement, in particular regarding transparency and rules: technical preparation for the agreement of the Rulebook; strengthening the reporting system.
COP24	2018, Katowice, Poland	Adoption of detailed rules for the implementation of the Paris Agreement (Katowice Rulebook). Definition of clear mechanisms for reporting, transparency, NDC; a key step towards the practical implementation of the agreement.
COP25	2019, Madrid, Spain	Updating NDC commitments; negotiations on Article 6 (market mechanisms). Legal basis for global carbon market prepared.
COP26	2021, Glasgow, United Kingdom	Glasgow Climate Pact: 1.5°C commitment; strengthening NDCs; 'net zero emissions': the beginning of a global transition to decarbonisation.
COP27	2022, Sharm El Sheikh, Egypt	Decision to establish a Fund for countries most affected by climate change

[22] *Conference of the Parties (COP).* United Nations Framework Convention on Climate Change (UNFCCC). https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop.

[23] *The Paris Agreement.* United Nations Framework Convention on Climate Change (UNFCCC). https://unfccc.int/process-and-meetings/the-paris-agreement

[24] Guesmi, Khaled, Kamel Si Mohammed, and Sunil Tiwari. "Green Horizons: Enabling the Energy Transition through Climate Change Policies." *International Review of Economics & Finance 94*, (2024): 103409. https://doi.org/10.1016/j.iref.2024.103409.

COP No.	Year, venue	Key decisions/significance
COP28	2023, Dubai, UAE	First Global Stocktake; agreement on the gradual reduction of fossil fuel use; focus on energy transition.
COP29	2024, Baku, Azerbaijan	Focus on financing and implementation, preparation for setting a new financial target after 2025.

Source: summarised by the authors based on[25].

Subsequent Conferences of the Parties strengthened the mechanisms for transparency, monitoring and review of nationally determined contributions, and specified the rules for market instruments under Article 6 of the Paris Agreement, which became the basis for the development of more structured carbon pricing mechanisms. An important direction was the gradual expansion of the financial commitments of developed countries, including the creation of a fund for loss and damage (Loss and Damage, for the implementation of COP19 decisions) and the confirmation of intentions to mobilise more than USD 100 billion annually to support developing countries in their efforts to mitigate and adapt to climate change. This provision gave political legitimacy to the idea of climate finance as a separate segment of the international financial system[26].

In fact, the Paris Agreement changed the paradigm of corporate finance by integrating climate risks into the capital management system. Institutional investors, banks and insurance companies began to re-evaluate their portfolios taking into account climate scenarios, which led to a shift from traditional profitability assessment to sustainability assessment of business models. As a result, the financial system has become a key instrument for implementing climate commitments, ensuring the flow of resources to low-emission sectors and stimulating the decarbonisation of production chains and trade supply chains.

Thus, the Paris Agreement served as a catalyst for the establishment of a global sustainable finance system aimed at integrating climate goals into all levels of economic activity, from public policy to corporate governance and investment decisions. Its implementation ushered in a new era in which financial flows became a determining factor in the pace and scale of the global economy's "green transition."

In response to deepening climate ambitions, the financial sector has transformed through the active proliferation of green bonds linked to sustainable development instruments, taxonomies for sustainable finance and climate reporting standards, as proposed by the TCFD (Task Force on Climate-related Financial Disclosures) and the ISSB (International

[25] *Conference of the Parties (COP)*. United Nations Framework Convention on Climate Change (UNFCCC). https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop.

[26] Climate Funds Update. *The Global Climate Finance Architecture* (CFF2). 2021. https://climatefundsupdate.org/wp-content/uploads/2022/03/CFF2-Global-CF-Architecture_ENG-2021.pdf

Sustainability Standards Board)[27]. Taken together, the COP21–COP29 decisions have stimulated the transition of financial markets to climate-oriented investment models, while shaping new requirements for transparency, risk assessment and decarbonisation of global value chains.

In particular, COP29 in Baku agreed on a new Collective Quantified Goal (NCQG): developed countries committed to providing USD 300 billion per year by 2035 for climate finance for developing countries, and the Baku-Belйm Roadmap was launched, calling on all sources (public and private) to increase support to USD 1.3 trillion per year. However, it is doubtful whether this will lead to the transformation of value chains towards more sustainable development. For example, as evidenced by L. Karlsen's study[28], although one of the conclusions of the COP29 conference in Baku was the recognition of the need for economically wealthy countries to provide funding for measures to overcome the effects of global warming in developing countries, this would allow the latter to maintain socio-economic stability without radical changes in their development models.

Financial mechanisms of the modern sustainable development architecture

As already noted, the Paris Agreement launched mechanisms that institutionalised the link between finance and climate policy. It contributed to the development of carbon pricing market instruments, green investment reporting systems, and the formation of non-financial disclosure standards, which later formed the basis of the TCFD and ISSB approaches. It was after COP21 that there was rapid growth in the issuance of green bonds, the emergence of new forms of investment, such as sustainability-linked loans and transition bonds, and the creation of specialised climate funds.

The most important distinction in the current market for 'sustainable' bonds is between bonds for specific purposes and bonds linked to the issuer's performance. Purpose-specific bonds (green, social, sustainable development bonds, transition bonds) focus primarily on projects, and the issuer is required to report on how the funds were spent (e.g., on the construction of a wind farm). On the other hand, bonds linked to the issuer's performance (SLBs) focus on specific goals and their achievement. For example, the funds can be used for any purpose, but if the issuer fails to achieve its KPIs (e.g., reduce CO_2 emissions by a certain percentage over a specified period), it must pay investors an increased coupon ('penalty'), which creates a financial incentive (Table 3).

[27] IFRS Official Website. "ISSB and TCFD." https://www.ifrs.org/sustainability/tcfd/

[28] Carlsen, Lars. "The Baku Paradox: An Analysis of Selected Sustainable Development Goals." *Sustainability 17*, no. 6 (2024): 2547. Accessed 28 March 2025. https://doi.org/10.3390/su17062547.

Table 3

MAIN TYPES OF BONDS ALIGNED WITH SUSTAINABLE DEVELOPMENT GOALS AND THEIR CHARACTERISTICS[29]

Type of bond	Key principle	Targeted use of funds	Characteristics of financial conditions	Main purpose
Green bonds	Targeted use (impact financing instruments)	Exclusively for environmental and climate projects (renewable energy, energy efficiency, green transport, pollution control).	Financial terms (coupon) are fixed or variable, *independent* of the issuer's environmental performance.	Financing of specific "green assets" and reduction of carbon footprint.
Social bonds		Exclusively for social projects (affordable housing, healthcare, education, food security, job creation).	The financial terms (coupon) are fixed and *do not depend* on the issuer's social performance.	Financing projects with a positive social impact, especially for vulnerable groups.
Sustainability bonds		For a combination of both environmental and social projects.	Financial terms (coupon) are fixed.	Financing of complex projects covering both environmental and social aspects of sustainable development.
Transition bonds		For financing projects that promote the transition to a low-carbon economy for companies in sectors that are difficult to decarbonise (e.g. metallurgy, cement industry).	The financial terms are fixed. They require a clear, scientifically sound transition strategy from the issuer.	To help companies with a significant carbon footprint gradually finance decarbonisation and modernisation.
Sustainability-linked bonds (SLBs)	Issuer performance	Funds are used for general corporate purposes (not earmarked).	Financial terms (usually the coupon) vary depending on whether the issuer has achieved pre-defined sustainability performance targets.	Encourages the transformation of the entire company and its business model in line with ambitious ESG goals, even in industries that do not have many "green assets".

[29] Summarised by the author based on World Bank. *Labeled Sustainable Bonds: Market Update — Issue No. 10.* 7 February 2025. https://thedocs.worldbank.org/en/doc/cd82b4033281dab2cb1a1c71eeb691e4-0340012025/original/Labeled-Bond-Quarterly-Newsletter-Issue-No-10.pdf; Shimauchi, Takuto, Masaki Fukui, Daiki Yamamoto, Yuto Taura, and Keigo Kameda. "Sustainability Bond, Sustainability-linked Bond, and Firms' Environmental Performance." *International Review of Financial Analysis 102*, (2025): 104127. https://doi.org/10.1016/j.irfa.2025.104127.

Green bonds can also be classified by issuer type. In particular, corporate green bonds are issued by private companies or financial institutions to finance environmentally-oriented projects. Government (sovereign) green bonds are issued by national governments to support the implementation of climate policy and the transition to sustainable development. Supranational green bonds are issued by international organisations such as the European Union, which began issuing such instruments in 2021 as part of the NextGenerationEU Green Bonds programme[30], or by international financial institutions such as the European Investment Bank.

According to the latest data from the Luxembourg Stock Exchange, supranational institutions have issued 2,743 bonds from 31 issuers for a total of EUR 1,028.92 billion, with the IBRD being the largest issuer (1,615 bonds). In regional terms, the EU is the leading region (8,534 bonds from 1,324 issuers), followed by Asia (8,267 bonds from 1,666 issuers), North America (2,219 bonds from 646 issuers), South America (2,219 bonds from 646 issuers), Oceania (307 bonds from 93 issuers) and Africa (205 bonds from 93 issuers). America (518 bonds from 200 issuers), Oceania (307 bonds from 93 issuers) and Africa (205 bonds from 64 issuers)[31]. Of these, only 3.3 per cent are fully compliant with the EU Taxonomy, while 17.5 per cent are partially compliant.

The largest number of green bonds are directed towards activities such as renewable energy, clean transport, green buildings, energy efficiency, and slightly smaller shares are directed towards rational use of water resources, pollution prevention and control, climate change adaptation, natural resources and land use, eco-efficient products and processes, and biodiversity. Of the social bonds, the largest number relate to access to critical services, socio-economic progress, job creation, affordable housing, and accessible infrastructure, and the smallest share relates to food security. In relation to the SDGs, the largest amount of funds is directed towards the following goals: "11. Sustainable Cities and Communities," "7. Affordable and Clean Energy," and "13. Climate Action" [32] . The main indicators of the impact of these financial instruments in the context of alignment with sustainable development goals are presented in Table 4.

[30] European Commission. *NextGenerationEU Green Bond Dashboard.* https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu-green-bonds/dashboard_en

[31] Luxembourg Green Exchange. Dashboard. https://lgxhub-premium.luxse.com/

[32] Ibid.

Table 4

IMPACT INDICATORS OF BONDS ALIGNED WITH SUSTAINABLE DEVELOPMENT GOALS[33]

Indicator	Available data	Per million EUR
Reduction/avoidance of annual greenhouse gas emissions	2,965,112,556.04 tCO2-e	768.1 t CO2-e/million EUR
Annual renewable energy production	4,738,890.49 GWh	1.22 GWh/million EUR
Annual energy savings	440,157.34 GWh	0.11 GWh/million EUR
Annual water savings	2,005,452,199.56 mi	519.5 mi/million EUR
Jobs created and/or preserved	11,214,872.85 jobs	2.9 jobs/million EUR

Although developed countries generate the majority of financial mechanisms and instruments for sustainable development, this does not automatically make them the leading factor in achieving sustainable development goals. According to a study by L. Karlsen[34], over the past twenty-four years, low-income countries, particularly African states, have demonstrated a relatively high level of compliance with climate action goals (SDG 13), while highly developed economies and OECD members have lagged significantly behind in achieving these targets. A similar asymmetry is observed in relation to ensuring sustainable production and consumption patterns (SDG 12). Therefore, further research is needed to assess the correlations and causal links between the development of sustainable finance instruments and the achievement of the SDGs.

It is worth noting that leading financial institutions are always primarily interested in companies, projects and investments that could potentially be involved in the next innovative breakthrough, competing for the best terms, and quite often projects related to achieving the SDGs promise better returns. Banks representing more than 40 per cent of global banking assets have joined the Net Zero Banking Alliance (NZBA), but today, many of the major financial market players have begun to leave the NZBA and other similar organisations due to political pressure against participation in climate alliances[35], [36]. Despite this, the development strategy of many financial institutions takes into account the market

[33] According to available data: Luxembourg Green Exchange. Dashboard. https://lgxhub-premium.luxse.com/

[34] Carlsen, Lars. "The Baku Paradox: An Analysis of Selected Sustainable Development Goals." *Sustainability 17*, no. 6 (2024): 2547. https://doi.org/10.3390/su17062547.

[35] Patel, P. "Financial Institutions Withdrawing from Net Zero Alliances." 2025. https://www.clearbluemarkets.com/knowledge-base/financial-institutions-withdrawing-from-net-zero-alliances

[36] Costa, M. "NZBA under pressure as Japanese banks leave." 2025. https://greencentralbanking.com/2025/04/03/nzba-under-pressure-as-japanese-banks-leave/

advantages of implementing more sustainable approaches. For example, Skandinaviska Enskilda Banken AB (SEB), in line with the values of its founders and shareholders, is committed to the principles of sustainable development; As one of the leading Scandinavian banks, SEB is deeply integrated into society and the economy and recognises its important mission to redirect capital to more sustainable areas and activities[37]. An important aspect of the strategy is risk diversification, as projects that comply with the EU Taxonomy or are favourable in the context of the Paris Agreement usually present lower risks. Moreover, it is in the field of environmental solutions, according to the SEB Group, that the next innovative breakthroughs are possible, which is a promising investment.

Thus, green lending and sustainable development loans (SLLs) occupy an important place in the financial architecture of sustainable development, shaping new rules for access to capital and encouraging companies to transform their business models. Unlike traditional credit instruments, green loans are directed exclusively towards financing environmentally-oriented projects — energy-efficient technologies, renewable energy, modernisation of logistics systems or waste management. Sustainable development loans have a broader focus: they do not restrict the use of funds, but link the cost of financing to the borrower's achievement of specific ESG indicators, such as reducing emissions, increasing resource efficiency, or ensuring greater transparency in supply chains. In this way, credit instruments become not only a source of financing but also a direct incentive to integrate sustainability principles into strategic company management.

The dependence of financing costs on ESG indicators is intensifying in the context of global regulatory competition caused by the Paris Agreement and the strengthening of countries' climate commitments. Financial institutions are increasingly taking non-financial risks into account when assessing the creditworthiness of companies, integrating environmental, social and governance factors into their pricing models. Companies with low ESG ratings face higher borrowing costs, limited access to investment resources and the need to provide additional guarantees, while companies with high sustainability ratings can qualify for lower interest rates or extended credit limits.

International financial organisations such as the EBRD, the World Bank, the IFC and others are making a significant contribution to the development of sustainable finance, acting as catalysts for transformation in developing countries. Through green lending programmes, grant mechanisms, guarantee instruments and technical assistance, they reduce

[37] SEB AB. 'SEB Asset Management Sustainability Review 2024 Including Active Ownership Report.' 2025. https://webapp.sebgroup.com/mb/mblib.nsf/alldocsbyunid/DD8E6A9A83CF9A8AC1258ACA00534A1A/USD FILE/SEB_AM_Sustainability_Review_.pdf

risks for the private sector and stimulate the attraction of private capital to low-carbon infrastructure projects. Their financial products serve not only as a source of resources, but also as a channel for the transfer of international norms, reporting standards, carbon risk assessment methodologies, and sustainable management practices.

Governments and regional integration associations are also creating conditions for the development of green financial architecture. For example, the European Climate Fund[38], small and medium-sized business support programmes, Just Transition Fund instruments and EU innovation programmes are aimed at accelerating the decarbonisation of the economy and improving resource efficiency. National governments are increasingly implementing incentive programmes: tax breaks for green investments, subsidies for energy-efficient technologies, guarantees for renewable energy projects. Such measures have a multiplier effect, enhancing the interaction of private, public and international resources.

At the same time, developing countries continue to experience limited access to green finance, which significantly narrows their opportunities for integration into modernised global value chains. The main barriers are high transaction costs associated with obtaining green loans and verifying environmental performance, insufficient expertise in environmental management, and limited institutional capacity. In many cases, companies do not have the necessary data or monitoring systems to meet the requirements of international investors, which increases the risk premium and reduces the availability of capital. International institutions (the World Bank, EBRD, IFC) are actively providing risk-sharing instruments and technical assistance, but the scale of needs exceeds available resources[39].

A separate challenge remains the need for global standardisation of sustainable finance instruments. As shown by a study of Japanese companies in 2017-2021 conducted by T. Shimaichi et al.[40], the issuance of sustainable bonds (SBs) and sustainability-linked bonds (SLBs) does not contribute to improving the environmental performance of companies. Therefore, as the authors emphasise, the introduction of clear rules on the use of proceeds is crucial to ensuring the effectiveness of such bonds. The process of harmonising approaches is ongoing and faces practical challenges, such as different approaches to the classification of environmentally sustainable assets, the lack of uniform verification

[38] Climate Funds Update. *The Global Climate Finance Architecture* (CFF2). 2021. https://climatefundsupdate.org/wp-content/uploads/2022/03/CFF2-Global-CF-Architecture_ENG-2021.pdf

[39] Charlene Watson, Liane Schalatek, and Aurélien Evéqu. “The Global Climate Finance Architecture.” 2022. https://climatefundsupdate.org/wp-content/uploads/2022/03/CFF2-Global-CF-Architecture_ENG-2021.pdf

[40] Shimauchi, Takuto, Masaki Fukui, Daiki Yamamoto, Yuto Taura, and Keigo Kameda. "Sustainability Bond, Sustainability-linked Bond, and Firms' Environmental Performance." *International Review of Financial Analysis 102*, (2025): 104127. https://doi.org/10.1016/j.irfa.2025.104127.

standards, and the widespread practice of greenwashing. These issues undermine investor confidence and create uncertainty for businesses. Initiatives to create sustainable finance taxonomies aim to address these discrepancies and ensure transparency of financial flows. Their implementation is a key prerequisite for the effective functioning of the global sustainable development architecture and the integration of countries with different levels of economic development into the transformed landscape of global value chains.

Transformations of global value chains after COP21

At the current stage of global economic development, the key drivers of the transformation of global value chains are profound changes in the business environment, affecting both technological and socio-economic processes. Firstly, new requirements from investors, who are increasingly focused on a comprehensive assessment of risks and non-financial parameters of companies' activities, are having a significant impact. Investors expect not only financial performance, but also transparent approaches to managing climate, social and operational risks, which automatically increases the importance of ESG-oriented financial instruments and stimulates the transformation of business models throughout the value chain.

Secondly, new consumer and labour expectations are shaping a different logic of interaction between companies and their stakeholders. Consumers are increasingly choosing brands that demonstrate real progress in sustainability, climate responsibility and ethical management practices. This shift in priorities is putting direct pressure on manufacturers, distributors and service companies, prompting them to reorient their production, logistics and marketing strategies in line with environmental and social sustainability values.

The third important factor is increased competitive pressure associated with the emergence of new products, business models and circular economy technologies on the path to Industry 4.0. The development of products based on recycled materials and upcycling and recycling approaches is becoming not only an innovative trend but also a strategic response to market expectations and growing resource constraints. Even large corporations such as Apple are integrating the use of secondary raw materials into their production processes, which signals a profound structural change in global value chains.

The fourth systemic factor of transformation is new regulatory requirements driven by a stronger global climate and environmental agenda. The expansion of compliance regulations, the introduction of

mandatory non-financial reporting, and the strengthening of traceability and transparency standards are shaping a new regulatory infrastructure that is affecting the structure, geography, and cost of global supply chains. Within this process, regulation is becoming not only a requirement but also a catalyst for innovation in financial instruments that support decarbonisation and sustainable resource management.

Thus, according to the EU Directive on Corporate Sustainability Reporting (CSRD), companies in the EU and some other countries must report not only on their emissions (Scopes 1-2), but also on the emissions of their entire supply chain (Scope 3)[41]. Specifically, according to preliminary plans, large companies already covered by the NFRD (listed companies, banks and insurance companies) will have to start reporting on supply chain emissions at the end of 2025, and in 2026–2028, such reporting requirements will gradually extend to other large companies and small and medium-sized enterprises listed on the stock exchange, depending on their size. However, only emissions that are "material" will be taken into account: how climate affects business and how business affects climate.

However, both in the US and the EU, some sustainability reporting requirements were relaxed in late 2024 — early 2025. For example, in April 2025, the European Parliament and the Council of the EU adopted the Stop-the-clock Directive (as part of the Omnibus[42]), which focuses on postponing the application of key sustainability directives[43]. The main reason given for this is the need to give businesses sufficient opportunity to prepare for changes that pose significant challenges and require considerable adaptation of processes. It is also expected that further simplification of sustainability reporting will be approved in 2025, as well as in the context of due diligence obligations for companies operating in the EU. It is also quite likely that the EU will postpone the Carbon Border Adjustment Mechanism (CBAM)[44], which concerns the introduction of a carbon "border tax" on imported carbon-intensive products (especially aluminium, cement, electricity, fertilisers, hydrogen, iron and steel).

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[41] BDO. "Q4 2024 Sustainability Reporting Jurisdictional Update. International Sustainability Reporting Bulletin 2025/02" (December 2024). https://www.bdo.ua/getmedia/4a2555d9-ec17-487a-88d1-f62eef7b7d54/ISRB_2025_02_ (final).pdf

[42] Omnibus packages are comprehensive regulations through which the European Commission seeks to unify and simplify EU legislation on supply chains in order to reduce the administrative burden on companies, in particular the Corporate Sustainability Due Diligence Directive (CSDDD) (*author's note)*. For more information, see: Centre for European Policy (cep). "Omnibus I: Revision of the Supply Chain Directive." 2025. https://www.cep.eu/eu-topics/details/omnibus-i-revision-of-the-supply-chain-directive.html

[43] Council of the European Union. "Simplification: Council Gives Final Green Light on the 'Stop-the-clock' Mechanism to Boost EU Competitiveness and Provide Legal Certainty to Businesses." Press release, 14 April 2025. https://www.consilium.europa.eu/en/press/press-releases/2025/04/14/simplification-council-gives-final-green-light-on-the-stop-the-clock-mechanism-to-boost-eu-competitiveness-and-provide-legal-certainty-to-businesses/

[44] European Commission. Carbon Border Adjustment Mechanism. https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

Finally, the current dynamics of global value chains are determined by increasingly frequent natural disasters, the consequences of global warming and the growth of climate risks. Companies are forced to strengthen their risk management approaches by rethinking their supply geography, dependence on individual resources, and potential vulnerabilities to climate shocks. These processes are unfolding against a backdrop of declining natural capital availability, depletion of productive resources, and structural changes in human capital, which reinforces the need for new management models and long-term investments in sustainability.

Events in recent years confirm that access to natural capital can no longer be considered a guaranteed institutional asset. Following the adoption of the Global Framework for Nature at COP15 in Kunming-Montreal (2022), natural capital has been given a status similar to that of the Paris Agreement as a strategic global priority[45]. This means that over the next two decades, global business will operate under radically changed rules of the game, where competitiveness will be determined not by the scale of available resources, but by the ability of companies to adapt to new environmental, regulatory and financial realities.

In summary, the main eco-transformations of global value chains, given the goals and consequences of international climate policy and changes in the economic and natural environment, are motivated by several factors, namely:

- regulatory requirements for reporting greenhouse gas emissions (Scopes 1-3) and reporting on the effectiveness of environmental, social and corporate governance;
- the need to align with the goals and requirements of shareholders and, more broadly, company stakeholders;
- competition for access to financial resources at reduced rates;
- increasing the company's investment attractiveness;
- opportunities to improve operational efficiency through better energy and resource efficiency;
- the need to improve operational and strategic resilience in the face of climate challenges and risks;
- building a positive image and practices of an ESG-responsible company, which has a positive impact on "chain" competitiveness in terms of partnership opportunities in value chains and supply chains, as well as on the market competitiveness of products/services.

Given the relative recency of global efforts to combat global warming and achieve the SDGs, it is quite difficult to preliminarily assess their

[45] Damania, Richard, Stephen Polasky, Mary Ruckelshaus, Jason Russ, Markus Amann, Rebecca Chaplin-Kramer, James Gerber, et al. 2023. Nature's Frontiers: Achieving Sustainability, Efficiency, and Prosperity with Natural Capital. Environment and Sustainable Development series. World Bank. http://hdl.handle.net/10986/39453 doi: https://doi.org/10.1596/978-1-4648-1923-0

effectiveness. However, in this regard, an analysis of the dynamics of global greenhouse gas emissions by country for the period 1970-2024 by income level (Fig. 1) and by region (Fig. 2) reveals structural inequalities in responsibility for climate change and the pace of decarbonisation. Visualising these dynamics, especially given the possibility of at least a preliminary analysis of the impact of sustainable development policies and climate finance almost 10 years after the Paris Agreement, makes it possible to clearly show which regions and economic groups are the largest sources of emissions and, accordingly, on which entities sustainable development financial mechanisms can have the greatest impact. This approach also helps to correlate the level of economic development and innovation with the effectiveness of ESG policies and green financing at the global level.

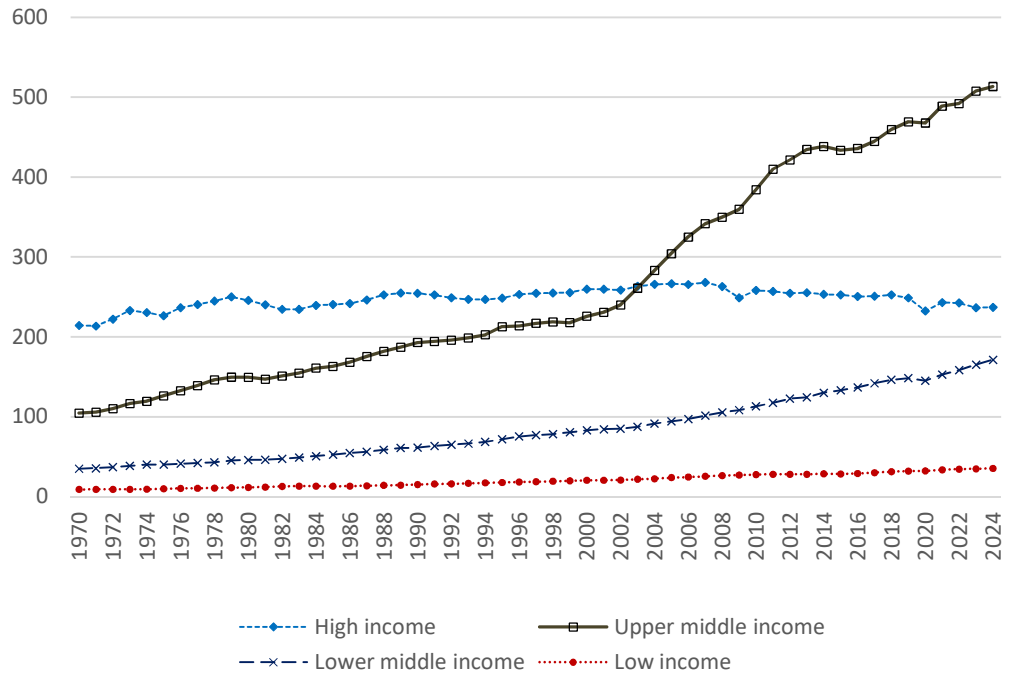

Fig. 1. Average greenhouse gas emissions by country group by income level[46] (1970-2024), metric tonnes of CO_2 equivalent per year.

Source: compiled by the author based on data from[47].

[46] According to the World Bank classification, 2025.

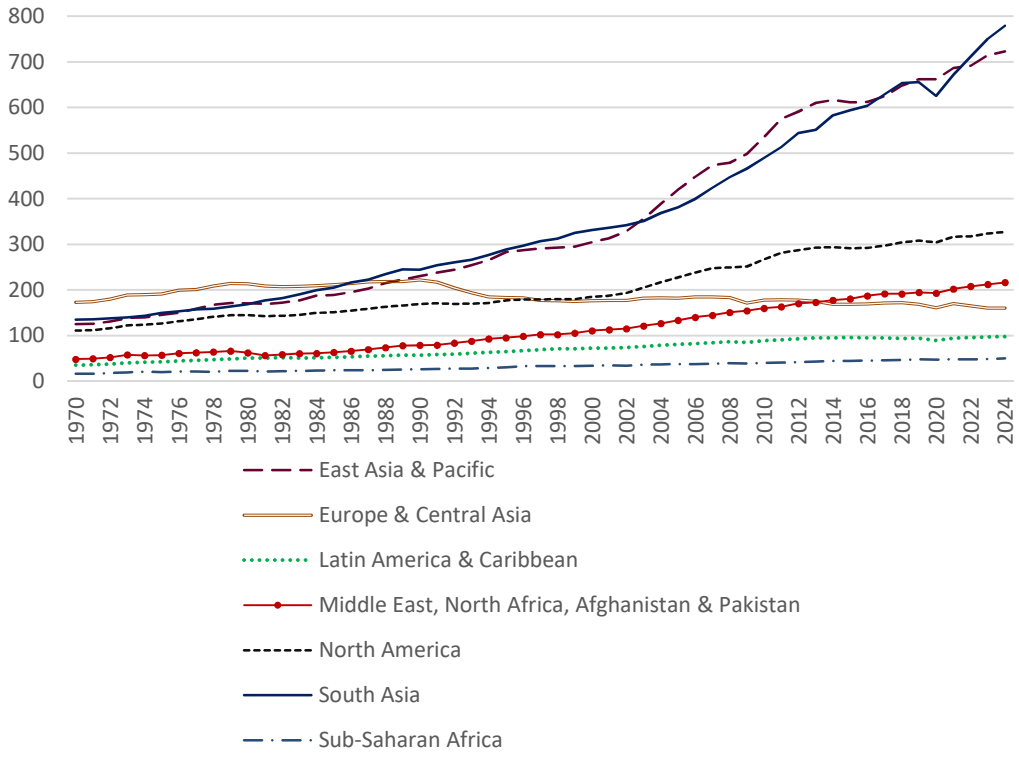

Fig. 2. Average greenhouse gas emissions by country group by geographical region (1970-2024), metric tonnes of CO_2 equivalent per year

Source: compiled by the author based on data from[48].

Thus, countries with above-average incomes have seen steady accelerated growth in greenhouse gas emissions since the early 2000s, which in regional terms is reflected in the rapid increase in emissions in East Asia and the Pacific region, as well as South Asia. A certain reduction in emissions is characteristic of a group of high-income countries, with the most significant decline recorded in the group of European and Central Asian countries since the 1990s, illustrating the actual consequences of the active

[47] European Commission, Joint Research Centre. *Emissions Database for Global Atmospheric Research (EDGAR) Report 2025.* https://edgar.jrc.ec.europa.eu/report_2025;
Crippa, M., Guizzardi, D., Pagani, F., Banja, M., Muntean, M. et al. 2025. GHG emissions of all world countries — 2025 Report, Publications Office of the European Union, Luxembourg, 2025, doi:10.2760/9816914, JRC143227.

[48] Crippa, M., Guizzardi, D., Pagani, F., Banja, M., Muntean, M. et al. 2025. GHG emissions of all world countries — 2025 Report, Publications Office of the European Union, Luxembourg, 2025, doi:10.2760/9816914, JRC143227.

implementation of corporate strategies for outsourcing production capacities, in particular the "brown" economy.

Further visualisation of the group of European and Central Asian countries shows a decrease in greenhouse gas emissions since the 1990s, primarily in high-income EU countries (Fig. 3). In this group of countries, the financial crisis of 2008-2009, as well as the consequences of the Covid-19 pandemic and the restrictions it caused (2020), had a more pronounced effect on the reduction of greenhouse gas emissions.

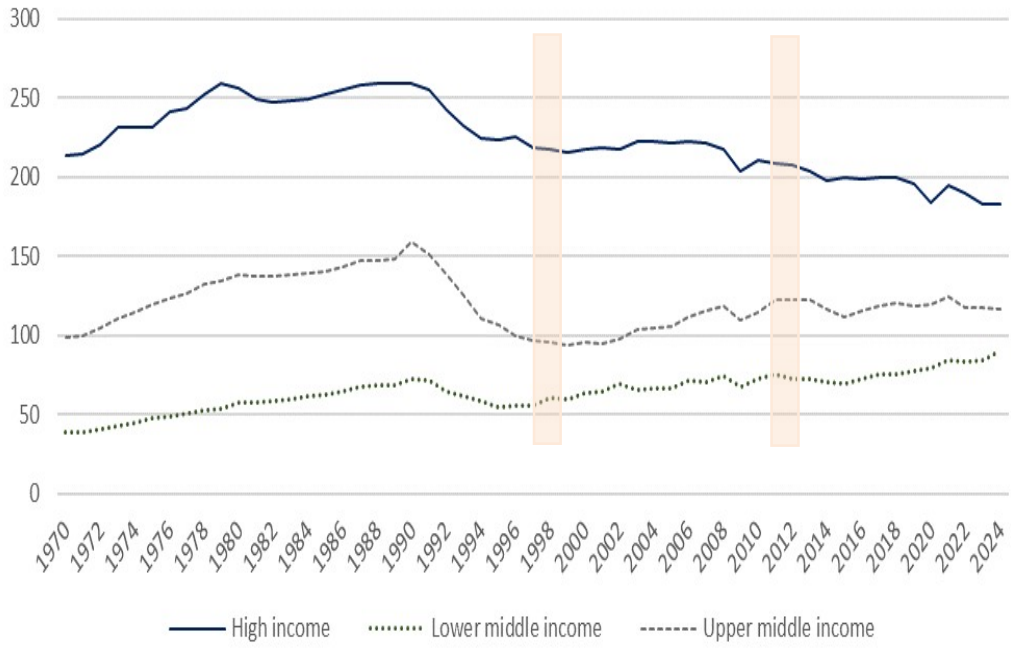

Fig. 3 — Average greenhouse gas emissions of groups of countries in Europe and Central Asia by income level (1970-2024), metric tonnes of CO_2 equivalent per year.

Source: compiled by the author based on data from[49].

Therefore, despite efforts to reduce the use of fossil fuels, due to a lack of alternatives and growing demand for energy resources, the global economy has not yet embarked on the path of abandoning them. This situation is generally facilitated by the structure of the dominant value chains that emerged during the Industry 3.0 era and remain dominant

[49] Ibid.

today. This can be illustrated, in particular, by the growing dynamics of the primary plastics market.

According to a study by K. Hossini et al.[50], in 2022, 98 per cent of the global volume of virgin plastic was produced from raw materials obtained from fossil fuels (namely, 44 per cent from coal, 40 per cent from oil and 8 per cent from natural gas, respectively), while only 9 per cent of the total volume of virgin plastic produced is recycled. In 2023, the largest exporters and importers of plastics and plastic products were China (exports of USD 124 billion, imports of USD 63.7 billion), the United States (exports of USD 89.1 billion, imports of USD 79.6 billion) and Germany (exports of USD 80.4 billion, imports of USD 50.1 billion). Global trade in plastics and plastic products grew at an average annual rate of 2.47 per cent between 2018 and 2023, reaching USUSD 745 billion in 2023[51]. According to Fortune[52], the average annual market growth rate is projected to be 5.1 per cent in 2025-2032.

The interconnectedness and complexity of global plastic supply chains significantly slows down the implementation of solutions to reduce the industry's negative impact. International efforts to protect ecosystems in this regard are still in their infancy. The Global Plastics Treaty, which aims to lay the foundations for reducing plastic pollution at all stages of its life cycle, from production to disposal, is currently only at the discussion stage. Given that the main drivers of growth are demand from the packaging and electric transport manufacturing industries[53], the main focus today is on reducing the use of single-use plastics and packaging made from them, which requires globally coordinated action aimed, in particular, at regulating fast-moving consumer goods (FMCG) manufacturers.

One of the key consequences of the strengthening of global climate policies after COP21 has been the growing likelihood of individual countries and companies being excluded from export markets due to the non-compliance of their production processes with climate requirements. The introduction of the Carbon Border Adjustment Mechanism (CBAM) by the European Union is a prime example of this trend: it effectively integrates the carbon footprint into the structure of international trade, turning climate policy into an instrument of competition and regulatory pressure. In such conditions, export-oriented manufacturers, especially those from developing countries, are faced with the need for rapid

[50] Houssini, Khaoula, Jinhui Li, and Quanyin Tan. "Complexities of the Global Plastics Supply Chain Revealed in a Trade-linked Material Flow Analysis." *Communications Earth & Environment 6*, no. 1 (2025): 257. https://doi.org/10.1038/s43247-025-02169-5.

[51] OEC. “Plastics and articles thereof.” https://oec.world/en/profile/hs/plastics-and-articles-thereof#bespoke-title-925

[52] Fortune Business Insights. “Plastics Market Size, Share & Industry Analysis, By Type.” https://www.fortunebusinessinsights.com/plastics-market-102176

[53] Ibid.

adaptation: improving energy efficiency, reducing emissions and introducing more transparent environmental reporting are becoming prerequisites for access to markets with high regulatory standards.

At the same time, changes in the regulatory environment and investor expectations following COP21 are causing a large-scale reorientation of capital flows towards sustainable technologies and low-carbon infrastructure. For companies, participation in global value chains increasingly depends on their ability to integrate investments in decarbonisation of production, modernisation of transport and logistics systems, reducing energy costs, and developing green innovations, which in turn requires further improvements in the information and analytical support of economic systems and is in line with the principles of Industry 4.0. Such a transformation is not exclusively a requirement of regulators, but is also shaped by financial instruments, in particular green bonds, ESG-oriented funds and sustainable credit lines, which create a new architecture of incentives. As a result, the transformation of global value chains after COP21 is happening simultaneously due to the risks of market loss and the opening of new opportunities for those participants who are the first to invest in sustainable technological and operational advantages, and above all, such transformations are associated with companies operating in EU countries and high-income countries.

Introduction of sustainable financing instruments in Ukraine

According to the law, environmental projects in Ukraine can be implemented by the state of Ukraine (represented by authorised bodies), local communities (represented by local government bodies) or private legal entities.

In the context of greening the economy, Ukraine has adopted a Strategy for Environmental Modernisation of Industry until 2030[54] and a National Economic Strategy-2030[55] at the state level, which provide for reducing emissions, developing a circular economy and supporting energy-efficient technologies. The state also uses economic incentives, in particular the Energy Efficiency Fund of Ukraine[56] provides grants for the modernisation of production, and the programmes "Energy Efficiency in Communities" supported by GIZ and the EBRD, "Green Economy Financing Facility"

[54] Ministry of Economy of Ukraine. *Strategy for the Environmental Modernisation of Ukraine's Industry until 2030*. 2023. https://www.me.gov.ua

[55] Cabinet of Ministers of Ukraine. National Economic Strategy for the Period until 2030. 2021. https://nes2030.org.ua

[56] Energy Efficiency Fund of Ukraine. *Official website*. 2024. https://eefund.org.ua

(GEFF)[57] finance the renewal of logistics infrastructure. An important tool is the state's "green" procurement, implemented through the Prozorro Market system, which gives priority to environmentally friendly goods and suppliers.

Even despite the challenges of martial law, taking into account the EU's "green course" and Ukraine's European integration development vector, foreign economic entities are focused on opportunities to increase competitiveness in European markets, which includes the need to consider and implement ESG principles. In particular, standardised reporting on sustainable development is becoming an important tool for Ukrainian companies to enter European value chains: it provides access to markets and capital, helps to improve operational efficiency and reduce risks.

The banking sector is actively involved in eco-transformation processes. The leader in green financing among Ukrainian banks is JSC Ukrgasbank, which was one of the first in the market to start financing climate measures and, in partnership with the International Finance Corporation (IFC), implements lending programmes for energy-efficient and renewable projects, particularly in transport and production logistics.

JSC Ukrgasbank's transformation began in 2015, and in 2016, the bank entered into a partnership with the IFC to implement its promising climate strategy. In May 2018, the bank became the first Ukrainian member of the Carbon Pricing Leadership Coalition, an association of businesses, governments and civil society organisations supported by the World Bank Group that advocates for the expansion of carbon pricing policies. In 2019, Euromoney recognised JSC Ukrgasbank as the best bank in Central and Eastern Europe for sustainable finance. In January 2021, to further strengthen the bank's mission, the IFC invested €30 million in the bank with the option to convert into shares in order to increase the share of green energy in the energy balance and improve the efficiency of final energy consumption in various industries. The investments raised are intended to finance relevant sustainable energy projects in Ukraine. During the first five years of its partnership with the IFC, the bank provided more than USD 1 billion in green loans for medium- and large-scale climate projects that are expected to prevent approximately 1.4 million tonnes of carbon dioxide emissions per year, and achieved a situation where more than half of its loans to small and medium-sized enterprises are green loans. For the next five years, until 2027, the bank has set a goal to make up about half of its total loan portfolio from "green" loans, which would prevent emissions of 1.9 million tonnes of carbon dioxide per year[58].

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[57] European Bank for Reconstruction and Development. *Green Economy Financing Facility (GEFF) in Ukraine.* 2023. https://www.ebrdgeff.com/ukraine

[58] IFC. "Ukraine's First Green Finance Bank Backs Climate-Smart Businesses." 2021. https://www.ifc.org/en/stories/2021/ukrgasbank?utm

To achieve this goal, the bank has integrated IFC Performance Standards into its green loan agreements and has become the first bank in Ukraine to integrate an environmental and social risk management system into its operations, make significant changes to its corporate governance practices, and create a green finance team.

Activities in the field of lending to energy projects based on sustainable development are extremely relevant for Ukraine, as it is one of the most energy-intensive economies in the world and is heavily dependent on nuclear, coal and gas energy. The issue of energy independence is particularly acute today in the context of martial law, when there is an urgent need to finance the restoration of power generation facilities. JSC Ukrgasbank has become the first Ukrainian bank to cooperate with PFAN, a private financial advisory network that provides expert and investment support for renewable energy projects. This cooperation will help overcome investment barriers and attract funds to promising Ukrainian projects, and the bank's clients will receive a free assessment of investment potential, business model development and assistance in preparing the necessary documents[59].

The bank's activities in the field of green lending significantly contribute to the achievement of the government's goals of increasing the share of renewable energy sources in the country's total energy production from 8 per cent to 17 per cent by 2030. Since transforming its mission and offerings, the bank has established itself as one of the top five national banks in terms of assets and as a bank serving SMEs, as well as the number one bank in trade finance in Ukraine, with a trade finance portfolio of over UAH 11.2 billion. The development of this area as one of the bank's priorities is due to the implementation of a wide range of services for documentary and non-documentary forms of international settlements in the bank's product range, as well as their constant updating and improvement. Its leadership in this area has been confirmed by a prestigious international award from the EBRD and recognition by the Export-Credit Agency (ECA) for its significant support to Ukrainian exporters, namely facilitating exports worth UAH 2.9 billion[60].

Thus, cooperation between international organisations, the state and the commercial banks, creates a favourable ecosystem for the development of green supply chains. Strategic priorities are formed at the macro level, while banks provide financial support and assess the sustainability of businesses. This synergy contributes to the greening of Ukraine's economy and increases its competitiveness in the European market.

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[59] Ukrgasbank. *Eco-banking*. https://www.ukrgasbank.com/eco/pfan

[60] Ukrgasbank. *Annual Report and Sustainability Report 2024*. 2025. https://www.ukrgasbank.com/upload/UGB_AnReport_UKR_24.pdf

The most active implementation of sustainable development financial instruments in Ukraine is in the energy sector, which is in line with global trends. The first company to issue green Eurobonds was DTEK LLC in 2019, placing bonds on the Irish Stock Exchange. In 2022, PJSC "NPC "Ukrenergo" also placed green sustainable development bonds on the London Stock Exchange for a term of 5 years, raising USD 825 million in financing[61].

Ukrainian companies operating in the energy sector also issue green loans (Table 5). In particular, in 2025, DTEK Renewables LLC began issuing carbon credits[62]. According to DTEK, one of the companies is certified to issue carbon credits by the International Carbon Registry (Iceland). According to the methodology of this registry, 1 carbon credit in Ukraine corresponds to a reduction in emissions of 1 tonne of CO_2 through the production of 1.56 MWh of energy from renewable energy sources.

Table 5

CARBON CREDITS ISSUED BY UKRAINIAN ORGANISATIONS AND INDEPENDENTLY VERIFIED BY THE INTERNATIONAL CARBON REGISTRY (ICR)

Years of results reduction in greenhouse gas emissions[63]	Project name	Confirmed estimate of greenhouse gas emission reductions	Issued ex-post ICCs	Available ex-post ICCs	Type	Credit start date
2022-2032	Tiligulska Wind Farm	10,732,118	256.68	256.68	Avoidance/ Reduction	01.02.2022
2019-2029	Pokrovska Solar Farm	2,274,439	913,736	913,736	Avoidance/ Reduction	01.10.2019
2019-2029	Prymorska Wind Farm	2,261,429	648,283	648,283	Avoidance/ Reduction	01.03.2019
2019-2029	Orlivska Wind Farm	2,249,859	528.5	528.52	Avoidance/ Reduction	01.10.2019
2019-2029	Prymorska Wind Farm 2	2,059,750	498,676	498,676	Avoidance/ Reduction	01.09.2019
2019-2029	Nikopolska Solar Farm	1,901,129	879.99	879.99	Avoidance/ Reduction	01.03.2019
2019-2029	Ovid Wind Farm Project	742,392	273,352	262,216	Avoidance/ Reduction	01.05.2019

Source: compiled based on data from[64].

[61] Ukrenergo. Green Bonds for Sustainable Development 2028. https://ua.energy/pro_kompaniyu/dlya-investoriv/yevroobligatsiyi-2026/

[62] DTEK Renewables. "DTEK Renewables Issues First Carbon Credits." 10 January 2025. https://renewables.dtek.com/media-center/press/dtek-renewables-issues-first-carbon-credits-ukraine/

[63] Based on a verified assessment of greenhouse gas emission reductions for previous ICCs or verified VVB for subsequent ICCs (author's note: according to Carbon Registry. *Credits Overview.* https://www.carbonregistry.com/credits.)

[64] Carbon Registry. *Credits Overview.* https://www.carbonregistry.com/credits.

A pressing practical issue is the readiness of Ukrainian companies for the green transition, given the challenges of wartime. Even with the inflow of significant investment resources, particularly in the context of EU integration and other programmes (GEFF[65], NEFCO[66], Ukraine Investment Framework[67] (part of *Ukraine Facility*, etc.)[68], there remains insufficient understanding of the economy's real capacity to absorb large-scale investments, since the start of the war in February 2022, value chains and supply networks have changed significantly, and the cost of implementing the necessary projects will be higher than it was before the war. An important factor in the successful implementation of reconstruction and sustainable development projects is improving the capacity of the state and local authorities to plan effectively.

Conclusions

The role of supranational organisations, the state and financial institutions, in particular banks, in stimulating the environmental transformation of value chains is crucial for the transition of the global economy to sustainable development.

Coordination and synergy between the private sector, states and international organisations is a key factor in the success of such transformations. The state acts as a regulator and driving force for change, creating regulatory and legal conditions that encourage enterprises to implement environmentally friendly technologies. Through a system of environmental standards, tax incentives, subsidies and grants, the government stimulates the modernisation of production, transport logistics and waste management. Green public procurement is also an important tool, creating demand for products with reduced environmental impact. Banks, in turn, act as financial intermediaries and catalysts for environmental investments. They introduce green lending, issue green bonds, and integrate ESG criteria into the customer assessment process, reducing support for businesses that harm the environment. Such financial instruments make environmental innovations more accessible to businesses of all sizes.

However, given the delay in the implementation of some regulatory requirements related to sustainable development, as well as the significant

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weakening of the positions of financial "zero-emission alliances," this trend is expected to intensify in the future as a result of geopolitical instability and macro-financial pressure. Therefore, at the current stage, sustainable financing mechanisms are being implemented more in view of market factors, and their impact on global supply chains, although quite noticeable in EU countries (which have significantly reduced greenhouse gas emissions since the 1990s), is much less relevant to the rest of the world. Therefore, it can be concluded that the transformation processes in supply chains towards the integration of sustainable development practices are currently driven more by the potential for increased efficiency, competitiveness and sustainability than by regulatory requirements. From the perspective of participants in global value chains, the successful integration of sustainable development financial instruments is currently a key condition for the long-term competitiveness of companies.

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