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EU's Dual Transformation: The Synergy of Green and Digital Transitions

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ABSTRACT. This article examines the European Union's concept of the 'twin transition' — a strategic approach to the simultaneous implementation of the green and digital transitions as interlinked and mutually reinforcing processes of systemic restructuring of the European economy. It traces the evolution of the concept from the EU Green Deal (2019) and the Industrial Strategy (2020) to the Berlin Declaration (2020) and the European Commission's Strategic Foresight Report (2022), in which the tension between the two transitions is systematically documented for the first time. The legal framework for the green transition is outlined: Climate Act (2021), which enshrined legally binding targets to reduce greenhouse gas emissions by 55 per cent by 2030 and achieve climate neutrality by 2050, and the 'Fit for 55' package. The experience of implementing the 'Fit for 55' package as of 2024 has been summarised: the EU has reduced greenhouse gas emissions by 39 per cent from 1990 levels whilst GDP has grown by 71 per cent, which empirically confirms the possibility of decoupling economic growth from emissions. The targets of the 'Digital Decade 2030' programme have been systematised across four areas — digital skills, infrastructure, the digitalisation of business and public services — along with the funding architecture for both transitions, totalling over EUR430 billion through the Recovery and Resilience Facility, the 'Digital Europe' programme and the national roadmaps of Member States. It has been found that synergies between the transitions are real, though not automatic: digital technologies simultaneously contribute to the decarbonisation of other sectors whilst themselves generating a growing energy burden — 8-10 per cent of the EU's final energy consumption, with data centres projected to grow from 70 to 115 TWh by 2030. Attention is drawn to the structural asymmetry of progress: 55.6 per cent of citizens with basic digital skills against a target of 80 per cent, only 19.5 per cent of women among ICT professionals, a 1 per cent increase in transport sector emissions by 2024, and uneven progress across Member States. It is shown that the institutional developments of 2024–2025 — the Artificial Intelligence Act (Regulation 2024/1689), the Omnibus Package and the Stop the Clock Directive — mark a transition from a phase of

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linear escalation of commitments to a phase of pragmatic adjustment of the pace amid geopolitical turbulence. It is argued that overcoming structural contradictions between the transitions and establishing integrated governance mechanisms is a prerequisite for achieving EU climate neutrality by 2050.
KEYWORDS: twin transition, EU Green Deal, Digital Decade, climate neutrality, digitalisation, Fit for 55, AI Act, Omnibus, Stop the Clock, Digital Compass 2030.

Introduction

The concept of the ‘twin transition’ — the simultaneous implementation of the green and digital transitions — has occupied a central place in the European Union’s strategic agenda since 2019–2020. Its conceptual foundations are laid in the EU Green Deal and the EU Industrial Strategy, which established the interdependence of climate and digital goals as a systemic principle of European development policy. In the European Commission’s policy documents, both transitions are characterised as inextricably linked: digitalisation is defined as a key instrumental factor in achieving climate neutrality, whilst the green transition forms a new technological and innovative framework for the digital economy.

The relevance of this study stems from the scale of the EU’s declared commitments and the existence of structural contradictions between the two transitions. The Union has adopted legally binding commitments to reduce net greenhouse gas emissions by 55 per cent by 2030 and achieve climate neutrality by 2050, whilst simultaneously setting digital targets under the ‘Digital Decade 2030’ programme — ensuring basic digital skills for 80 per cent of citizens and increasing the number of ICT professionals to 20 million. However, research by the Joint Research Centre (JRC) indicates that the growing demand for electricity from digital technologies, particularly artificial intelligence systems, could conflict with climate priorities if renewable generation is insufficiently developed. Consequently, there is not only synergy but also a potential conflict of objectives between the two transitions. An additional factor contributing to the relevance of this issue is the institutional changes of 2024–2025 — the adoption of the Omnibus Package and the Stop the Clock Directive — which signal a shift towards a phase of pragmatic adjustment of the pace of the green transition and require independent analytical consideration.

The aim of this article is to provide a systematic analysis of the regulatory framework, quantitative targets, funding mechanisms, points of synergy and contradictions, as well as the current progress of both transitions, based on official documents and monitoring reports from EU institutions for the period 2019–2025. To achieve this aim, the following tasks have been set: (1) to outline the conceptual evolution of the dual transition; (2) to analyse the legal framework and the state of implementation of the green transition; (3) to systematise the targets and current progress of the Digital Decade 2030; (4) to identify mechanisms of synergy and systemic risks; (5) to assess the impact of institutional reforms in 2024–2025 (AI Act, Omnibus, Stop the Clock) on the trajectory of the dual transition.

The methodological basis of the study consists of a systems analysis — to consider the dual transition as a single system rather than the sum of two autonomous strategies; a comparative method — to compare quantitative targets and the current state of implementation for both transitions; content analysis of legislative acts, strategic documents and monitoring reports from the European Commission, the Joint Research Centre (JRC), the European Environment Agency (EEA) and Eurostat for 2019–2025. The empirical basis of the study is formed on the basis of the 'State of the Digital Decade' reports (2024, 2025), progress reports on the implementation of the Climate Law (EEA, 2025) and the regulations of the 'Fit for 55' package.

State of research on the issue

The concept of dual transformation as an integrated object of analysis has emerged in academic research relatively recently — from 2020–2021, following the institutionalisation of the relevant EU policy course. Among international researchers, a fundamental contribution to the development of the concept was made by a group of authors from the European Commission's Joint Research Centre — S. Munch, E. Stormer, K. Jensen, T. Asikainen, M. Salvi and F. Scapolo[2], who, in the JRC report 'Towards a green and digital future' identified three key mechanisms for synergy: improving energy efficiency through digital twins, optimising energy grids using artificial intelligence, and ensuring the traceability of material flows in the circular economy. Analysts at the Bertelsmann Foundation[3] are investigating the impact of the dual transition on the future of the labour market in OECD countries, focusing on the shortage of digital-green skills. A critical perspective on the concept is presented in the article by Z. Kovacic and co-authors[4], who highlight the risks of excessive optimism regarding synergies and emphasise the need for empirical verification of the claimed effects.

The works by K. Geremi, K. Si Mohammed and S. Thivari[5] are devoted to the regulatory framework of the Green Deal and its implementation, analysing the impact of climate regulations on the energy transition and the effectiveness of market mechanisms. The structural nature of the gap between the Green Deal's objectives and instruments is

[2] Muench S., Stoermer E., Jensen K., Asikainen T., Salvi M., Scapolo F. Towards a green and digital future: Key requirements for successful twin transitions in the European Union. EUR 31075 EN. Joint Research Centre. Luxembourg: Publications Office of the European Union, 2022. 124 p. ISBN 978-92-76-52451-9. DOI: https://doi.org/10.2760/977331.

[3] Giesemann, Elisabeth. «The Future of Work in the Twin Transition to Green and Digital.» Originally published in '*System Updates: Resetting the Future of Work*'. BFNA, 2023. https://assets.ctfassets.net/9vgcz0fppkl3/3XO2r9DncF2OBXmq3yMYfJ/6316350091fe225fe38907a68cc96444/25012024_-2.pdf

[4] Kovacic Z., García Casañas C., Argüelles L., Yáñez Serrano P., Ribera-Fumaz R., Prause L., March H. The twin green and digital transition: High-level policy or science fiction? Environment and Planning E: Nature and Space. 2024. DOI: https://doi.org/10.1177/25148486241258046.

[5] Guesmi K., Si Mohammed K., Tiwari S. Green Horizons: Enabling the Energy Transition through Climate Change Policies. *International Review of Economics & Finance*. 2024. Vol. 94. P. 103409. DOI: https://doi.org/10.1016/j.iref.2024.103409.

examined by L. Carlsen[6] and P. Mure, S. Giorgio, V. Antonelli and L. Bitucci[7] , who highlight the discrepancy between the pace of the EU's regulatory ambitions and the actual readiness of businesses to adapt. In a special issue of the journal 'Industry and Innovation', D. Diodato, E. Uergo, P. Moncada-Paterno-Castello, F. Rentokkini and B. Timmermans[8] summarise the economic and social challenges facing EU countries as they simultaneously advance the green and digital transitions.

Research on the digital transition and the 'Digital Decade 2030' programme is primarily presented in institutional reports by the European Commission[9] and Eurostat[10] . In academic discourse, the key challenges of the digitalisation of the European economy are examined by T. Puschmann and D. Quattrocchi[11], who investigate the role of fintech tools in measuring Scope 3 emissions and integrating digital data into environmental reporting systems.

The systemic risks of the dual transition and the issue of energy consumption by digital infrastructure are actively explored in the works of S. Knut[12], G. Nyanjang, G. Padhana and A. Tiwari[13] , who analyse the tension between climate finance and digital infrastructure in developing countries. M. Cortez, N. Andrade and F. Silva[14] examine the financial performance of 'green' investments in the European market, demonstrating their comparability with traditional investment strategies.

Among domestic researchers, M. Sandul, Y. Strilchuk and O. Primierova[15] have made a significant contribution to the study of Ukraine's European integration in the context of the green and digital transitions, analysing the impact of sustainable development finance mechanisms on the evolution of global value chains. V. Kolosova[16]

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[6] Carlsen L. The Baku Paradox: An Analysis of Selected Sustainable Development Goals. *Sustainability*. 2025. Vol. 17, No. 6. P. 2547. DOI: https://doi.org/10.3390/su17062547.

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

[8] Diodato D., Huergo E., Moncada-Paternò-Castello P., Rentocchini F., Timmermans B. Introduction to the special issue on «the twin (digital and green) transition: handling the economic and social challenges». *Industry and Innovation*. 2023. Vol. 30, No. 7. pp. 755–765. DOI: https://doi.org/10.1080/13662716.2023.2254272.

[9] European Commission. State of the Digital Decade 2025 report. Brussels, June 2025. URL: https://digital-strategy.ec.europa.eu/en/library/state-digital-decade-2025-report

[10] Eurostat. Towards Digital Decade targets for Europe. Statistics Explained. Luxembourg, 2025. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Towards_Digital_Decade_targets_for_Europe

[11] Puschmann T., Quattrocchi D. Reducing the Impact of Climate Change in Value Chains through Sustainable Finance. *Journal of Cleaner Production*. 2023. Vol. 429. P. 139575. https://doi.org/10.1016/j.jclepro.2023.139575.

[12] Knuth S. «Breakthroughs» for a Green Economy? Financialisation and Clean Energy Transition. *Energy Research & Social Science.* 2018. Vol. 41. P. 220–229. https://doi.org/10.1016/j.erss.2018.04.024.

[13] Njangang H., Padhan H., Tiwari A. K. From Aid to Resilience: Assessing the Impact of Climate Finance on Energy Vulnerability in Developing Countries. *Energy Economics*. 2024. Vol. 134. P. 107595. https://doi.org/10.1016/j.eneco.2024.107595.

[14] Cortez M. C., Andrade N., Silva F. The Environmental and Financial Performance of Green Energy Investments: European Evidence. *Ecological Economics.* 2022. Vol. 197. P. 107427. https://doi.org/10.1016/j.ecolecon.2022.107427.

[15] Sandul M. S., Strilchuk Y. I., Primyera O. K. 'The Impact of Sustainable Development Financial Mechanisms on the Evolution of Global Value Chains.' *International Economic Policy,* vol. 1 (42). (2025): 27–58. https://doi.org/10.33111/iep.2025.42.02.

[16] Kolosova V. «The Importance and Prospects of International Financial Institutions' Assistance in the Country's Recovery.» *International Economic Policy*, vol. 2 (41). (2024): 132–148. https://doi.org/10.33111/iep.eng.2024.41.09.

examines the role of international financial institutions in Ukraine's recovery and its integration into the European Union.

An analysis of the sources reveals that, despite the significant volume of publications on individual aspects of the green and digital transitions, the concept of dual transformation as a single systemic entity remains relatively under-researched, particularly in domestic academic literature. Of particular relevance is the challenge of understanding the new institutional instruments for 2024-2025 — the Omnibus Package, the Stop the Clock Directive, and the Artificial Intelligence Act — as mechanisms for pragmatically adjusting the pace of the dual transition amid geopolitical turbulence. This defines the aim and objectives of this article.

The conceptual basis of the dual transformation

The concept of 'dual transformation' has developed gradually as the strategic thinking of EU institutions has evolved, rather than being introduced by a single legislative act. The EU Green Deal served as the foundational document that conceptually linked the green and digital dimensions, explicitly stating that digital transformation and its tools are key factors in fulfilling the Union's climate commitments[17]. The EU Industrial Strategy developed this logic, noting that the green and digital transitions will affect every part of the economy, society and industry, and that accelerating them simultaneously is a prerequisite for economic recovery following the COVID-19 pandemic[18]. The Berlin Declaration on the Digital Society, signed by ministers of the Member States in December 2020, enshrined at intergovernmental level the principle that Europe's digital transformation must be closely aligned with the objectives of the Green Deal, demonstrating the formation of a broad political consensus around the concept[19].

According to the findings of the Joint Research Centre (JRC), the synergistic effect of the dual transformation is realised through three key mechanisms: firstly, improving the energy efficiency of production processes through the introduction of digital twins and predictive maintenance systems; secondly, the optimisation of energy network management through artificial intelligence; thirdly, ensuring the traceability of material flows in the circular economy through distributed ledger technologies[20].

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[17] European Commission. The European Green Deal. Communication COM(2019) 640 final. Brussels, 11 December 2019. CELEX:52019DC0640. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640

[18] European Commission. Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery. Communication COM(2021) 350 final. Brussels, 5 May 2021. CELEX:52021DC0350. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0350

[19] European Commission, 2020. Berlin Declaration on Digital Society and Value-Based Digital Government. https://digital-strategy.ec.europa.eu/en/news/berlin-declaration-digital-society-and-value-based-digital-government

[20] JRC, 2022. Towards a green and digital future. https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/twin-green-digital-transition-how-sustainable-digital-technologies-could-enable-carbon-neutral-eu-2022-06-29_en

The EU Transition Pathways Initiative has confirmed these findings at sectoral level, revealing that none of the key industrial ecosystems — from steelmaking to agri-food — is capable of achieving climate goals without the simultaneous digitalisation of production and logistics processes, confirming the systemic, rather than sectoral, nature of the dual transition[21].

Alongside the synergistic potential, official documents from EU institutions also highlight the risks arising from the simultaneous advancement of two large-scale transformations. It is telling that it was only in the 2022 Strategic Foresight Report that the European Commission systematically addressed the tension between the two transitions — competition for limited investment, regulatory and human resources — for the first time, whereas in previous policy documents these risks were overlooked in favour of the narrative of synergy[22]. This indicates that the concept of dual transition has undergone a certain evolution: whilst at the initial stage the synergy between the two transitions was perceived as self-evident and did not require separate justification, subsequent implementation revealed the need for conscious management of the contradictions between them at the level of specific policy instruments and coordination mechanisms.

The most pressing structural challenge is the growing energy demand from the digital sector. According to the European Commission, digital technologies account for 8-10 per cent of total final energy consumption in the EU and generate 2-4 per cent of greenhouse gas emissions[23]. The report 'State of the Digital Decade 2025' notes a further intensification of this trend: the rapidly growing demand for electricity, linked to the increased use of artificial intelligence systems, is outpacing the development of clean energy supply and grid capacity across the EU, creating a structural barrier to the scaling up of key digital technologies[24]. Thus, the development of digital infrastructure without taking climate priorities into account directly threatens the fulfilment of the EU's green commitments — and therefore, the joint implementation of the two strategies is not an additional option, but a prerequisite for achieving climate neutrality by 2050.

A separate dimension of risk is the insufficient conceptual integration of both transitions at the implementation level. Research conducted as part of the 'Digitalisation and Sustainable Development at EU Level' project has found that, despite the declared unity of the green and digital agendas, both themes remain poorly integrated into a common strategic framework, and that environmental and social justice are not given sufficient operational weight in digital transformation processes[25]. This evi-

[21] EURAXESS, 2024. Roundup on the EU Green and Digital Twin Transition. https://euraxess.ec.europa.eu/worldwide/china/news/roundup-eu-green-and-digital-twin-transition

[22] European Commission, 2022. Strategic Foresight Report: Twinning the green and digital transitions in the new geopolitical context. https://commission.europa.eu/strategy-and-policy/strategic-planning/strategic-foresight/2022-strategic-foresight-report_en

[23] European Commission, 2022. Green digital sector. https://digital-strategy.ec.europa.eu/en/policies/green-digital

[24] European Commission, 2025. State of the Digital Decade 2025. https://digital-strategy.ec.europa.eu/en/policies/2025-state-digital-decade-package

[25] EURAXESS, 2024. In focus: The EU's Green and Digital Twin Transition. https://euraxess.ec.europa.eu/worldwide/asean/news/focus-eus-green-and-digital-twin-transition

dence confirms that the conceptual unity of the green and digital transitions does not guarantee their automatic alignment in practice — and therefore, managing their interaction requires independent institutional and regulatory support

Green transition: objectives, regulatory framework and implementation status

The dual transition is not merely a theoretical construct, but a strategic course enshrined in a specific regulatory framework. Its first and defining component is the green transition, the legal basis for which is formed by the European Green Deal, presented by the European Commission on 11 December 2019, which defined a new model of economic growth based on decoupling economic development from the growth of greenhouse gas emissions. It differs from the Union's previous climate strategies primarily in its legal status: in 2021, the key objectives of the Green Deal were enshrined in the European Climate Law as legally binding provisions, rather than as declarative political commitments. The law established two binding targets: achieving climate neutrality by 2050 — which will make the EU the world's first climate-neutral economy — and reducing net greenhouse gas emissions by at least 55 per cent by 2030 compared to 1990 levels[26]. These commitments were submitted to the UN Framework Convention on Climate Change in December 2020 as the EU's official contribution to the Paris Agreement, thereby giving them an international legal dimension.

In parallel with the implementation of the 2030 targets, the EU has begun shaping the next phase of its climate commitments. In February 2024, the European Commission recommended setting a 2040 target of a 90 per cent reduction in net emissions compared to 1990 levels. In July 2025, a corresponding amendment to the Climate Law was officially submitted to the European Parliament and the Council of the EU for consideration[27]. The EU's climate architecture thus takes on a coherent, multi-level structure with clear interim targets for 2030 and 2040 and a final target for 2050, each of which is underpinned either by existing legislation or a legislative proposal. It is worth emphasising that the formation of such an architecture is unprecedented in global climate regulation: no other supranational or national entity has a system of climate commitments comparable in scope and legal binding force.

However, enshrining these targets in law is only the first step — translating them into specific sectoral commitments and implementation tools is no less important. The overall target of a 55 per cent reduction in emissions required precisely such a translation, which was achieved by the 'Fit for 55' package presented by the European

[26] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality (European Climate Law). Official Journal of the European Union. 2021. L 243. P. 1–17. CELEX:32021R1119. URL: https://eur-lex.europa.eu/eli/reg/2021/1119/oj

[27] European Commission. Securing our future. Europe's 2040 climate target and path to climate neutrality by 2050. Communication COM(2024) 63 final. Strasbourg, 6 February 2024. CELEX:52024DC0063. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52024DC0063

Commission in July 2021. The package covered climate, energy, transport and tax policies and was adopted in full in 2023[28]. The adoption of the package in its entirety also had an immediate measurable effect: according to the European Commission's assessment, the cumulative result of the measures introduced exceeds the minimum threshold, and the expected reduction in emissions by 2030 stands at 57 per cent, rather than 55 per cent[29]. The key targets of the package are summarised in Table 1.

Table 1

KEY TARGETS OF THE 'FIT FOR 55' PACKAGE for 2030–2035[30]

Sector / instrument	Target	Timeframe
Renewable energy	42.5% of the total energy mix (ambition — 45%)	2030
Energy efficiency	Reduction in final consumption by 11.7% (compared to the 2020 baseline scenario)	2030
New passenger cars	100% zero CO_2 emissions	2035
New light commercial vehicles	100% zero CO_2 emissions	2035
Average emissions from new cars	A 55% reduction compared to 2021	2030
Social Climate Fund	EUR86 billion to support vulnerable citizens and SMEs	2026–2032
Carbon Border Adjustment Mechanism (CBAM)	Full implementation	2026

Data for 2024, published by the European Commission and the European Environment Agency (EEA) in November 2025, allow for an assessment of the immediate measurable impact of the measures taken. The overall result is positive: since 1990, the EU has reduced net greenhouse gas emissions by 39 per cent, whilst achieving 71 per cent GDP growth[31]. This result confirms in practice one of the key ideas of the Green Deal: the economy can grow without increasing greenhouse gas emissions. In 2024, the trend towards reducing emissions continued — a further decrease of 2.5 per

[28] European Commission. Stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our people. Communication COM(2020) 562 final. Brussels, 17 September 2020. CELEX:52020DC0562. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0562

[29] European Commission, 2023. Fit for 55: completion of key legislation. https://malta.representation.ec.europa.eu/news/commission-welcomes-completion-key-fit-55-legislation-putting-eu-track-exceed-2030-targets-2023-10-09_en

[30] European Commission. Stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our people. Communication COM(2020) 562 final. Brussels, 17 September 2020. CELEX:52020DC0562. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0562

[31] European Commission, 2025. EU advances towards 2030 climate targets with continued emissions cuts. https://climate.ec.europa.eu/news-other-reads/news/eu-advances-towards-2030-climate-targets-continued-emissions-cuts-2025-11-06_en

cent was recorded compared to 2023, indicating that the EU is moving in the right direction, although full implementation of all planned measures is necessary to achieve the 2030 target. A detailed overview of progress towards the targets by sector is provided in Table 2.

An analysis of the data presented allows for a nuanced assessment. On the one hand, the results for sectors covered by the Emissions Trading System (ETS) are convincing: a 51 per cent reduction from 2005 levels in the energy and industrial sectors demonstrates that carbon pricing as a regulatory tool is effective, and the target of a 62 per cent reduction by 2030 remains achievable. Renewable energy has become the leading source of electricity generation in the EU, representing a significant structural shift in the Union's energy mix.

Table 2

PROGRESS TOWARDS ACHIEVING THE EU'S SECTORAL CLIMATE TARGETS AS OF 2024[32] ;[33] ; [34]

Sector / instrument	2030 target	Status in 2024	Progress assessment
EU total net emissions	-55% vs 1990	−39% vs 1990 (−2.5% vs 2023)	⚠ On track provided measures are fully implemented
ETS — stationary installations (energy, industry)	-62% vs 2005	−51% vs 2005; −6% vs 2023	✓ On track to meet the target
ESR — overall (transport, buildings, agriculture, waste)	-40% vs 2005	−19.8% vs 2005; no change in 2024	⚠ Significant acceleration required
Transport (largest ESR sector, 39% of ESR)	ESR component	+1% in 2024 vs 2023	✗ Increase in emissions
Construction (22% of ESR)	-43% compared to 2005	No change in 2024	✗ Stagnation
Agriculture (18% ESR)	Non-CO_2 reduction	−1% in 2024 vs 2023	⚠ Minimal progress
Carbon sinks (LULUCF)	310 $MtCO_2e$ in 2030	Second consecutive improvement	⚠ Potential reversal of the negative trend

[32] European Commission. EU progress towards 2030 climate targets, November 2025. https://climate.ec.europa.eu/news-other-reads/news/eu-advances-towards-2030-climate-targets-continued-emissions-cuts-2025-11-06_en

[33] EEA. Progress towards national GHG emissions targets in Europe, 2025. https://www.eea.europa.eu/en/analysis/indicators/progress-towards-national-greenhouse-gas

[34] EEA. Trends and projections in Europe 2025. https://www.eea.europa.eu/en/analysis/publications/trends-and-projections-in-europe-2025

On the other hand, the sectors covered by the Effort Sharing Regulation (ESR) — transport, construction, agriculture and waste, which together account for over 65 per cent of total EU emissions — are showing a significantly slower rate of change. The projections for Member States, submitted in 2025, indicate that even with planned measures in place, the ESR sectors will only reach 38 per cent reduction instead of the target of 40 per cent reduction by 2030, and 17 out of 27 Member States will need to use flexibility mechanisms to meet their annual limits.

Overall, an analysis of progress across sectors suggests that the problem does not lie in a lack of legislation — the laws have been enacted and are binding. The main obstacle lies elsewhere: certain sectors, notably construction, transport and agriculture, are slow to change due to long investment cycles and their dependence on shifts in the behaviour of millions of households and businesses. Overcoming this structural inertia requires not only binding legal provisions but also the active implementation of new technologies — and it is digital tools, in particular smart consumption monitoring, the automation of production processes and the optimisation of resource use, that are capable of significantly accelerating the necessary changes. This makes digitalisation not a parallel but an integral part of the green transition, without which the achievement of the EU's climate targets by 2030 is unlikely.

Institutional adjustments in 2025: Omnibus and Stop the Clock

The dynamics of the Green Deal's implementation in 2024–2025 are characterised not only by an increase in commitments but also by the emergence of mechanisms for pragmatically adjusting the pace of the regulatory burden on business. A key institutional development in 2025 was the adoption by the European Commission on 26 February 2025 of the Omnibus I package (Simplification Package), which provides for the simplification and consolidation of a number of sustainable development regulations — the Corporate Sustainability Reporting Directive (CSRD), the Corporate Sustainability Due Diligence Directive (CSDDD), the Carbon Border Adjustment Mechanism (CBAM) Regulation, and the Taxonomy for Sustainable Investments. The package aims to reduce the administrative burden on small and medium-sized enterprises, minimise duplication between directives, and provide legal certainty for companies.

A key part of this process was the adoption by the European Parliament and the Council of the EU on 14 April 2025 of the 'Stop the Clock' Directive, which officially postponed the entry into force of certain provisions of the CSRD by two years for the second and third 'waves' of companies — those required to report on sustainability from 2026 and 2028 onwards. A similar postponement is provided for the CSDDD. The EU Council's reasoning is based on the need to give businesses more time to adapt their production processes and information systems to the new reporting requirements.

The institutional significance of these decisions goes beyond mere technical harmonisation of regulation. The Omnibus Package and the Stop the Clock Directive mark a qualitative shift in European Green Deal policy from the phase of 'linear escalation of commitments' (2019–2024) to the phase of 'pragmatic recalibration of the pace' (2025+). This paradigm shift reflects three objective factors: firstly, geopolitical turbulence (Russia's war against Ukraine, the 2022–2023 energy crisis, and US–EU–China tariff tensions), which has shifted the priorities of European industrial policy towards strategic autonomy; secondly, structural limitations on business readiness for the full-scale implementation of the CSRD, which became apparent in 2023–2024 through the example of the first wave of reporting companies; thirdly, competitive pressure from the US (Inflation Reduction Act 2022) and China, which are stimulating the green industry through direct subsidies rather than strict reporting requirements.

At the same time, Omnibus and Stop the Clock do not mean that the EU is abandoning the Green Deal's targets. The legally binding climate targets of the Climate Act (55 per cent by 2030, climate neutrality by 2050) remain unchanged, and in July 2025 the European Commission officially submitted an interim target of 90 per cent reduction by 2040 for consideration. However, the instrumental logic of implementation is changing: from detailed regulation of all processes to a focus on key indicators and selective instruments (CBAM as the main mechanism for environmental protectionism, the AI Act as a framework for digital synergy, and the ETS as the main financial mechanism).

In the context of the dual transition concept, the significance of these decisions lies in the fact that they simultaneously affect both transitions: the postponement of the CSRD slows down the integration of digital ESG reporting (i.e. the direct channel through which the digital transition supported the green one), whilst the simplification of the CBAM reduces pressure on industrial sectors, which are simultaneously the main consumers of digital decarbonisation technologies. This confirms the thesis that the green and digital transitions function as a single system, where regulatory adjustments to one block automatically affect the other.

The prospects for the green transition in the medium term (2026–2030) under the current turbulent conditions will be determined, firstly, by the pace of CBAM implementation in its full financial phase from 1 January 2026; secondly, by the EU's ability to maintain unity among Member States despite differences in industrial structure; thirdly, by the dynamics of global climate policy following COP30[35], which demonstrate a weakening of the international consensus on the pace of decarbonisation. Taken together, these factors make the EU's green transition more risky in terms of achieving the 2030 target, but at the same time open a window of opportunity for EU candidate countries, in particular Ukraine, which can use this phase of pragmatic adjustment to align its own regulatory environment with that of the EU on more realistic terms.

[35] The 30th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP30) took place in Belém (Brazil) in November 2025. URL: https://unfccc.int/cop30

Digital transition: The Digital Decade 2030

The strategic framework for the EU's digital transition is the Digital Decade Policy Programme (DDPP), adopted in 2022 as the first-of-its-kind joint digital strategy, agreed upon by the European Commission, the Parliament and the Council. A key feature of the DDPP is its measurable nature: unlike the declarative strategic documents of previous years, the programme has set specific quantitative targets across four areas and introduced a mandatory mechanism for annual monitoring through the 'State of the Digital Decade' reports[36]. The Programme's targets are summarised in Table 3.

These targets reflect a comprehensive understanding of digital transformation: it encompasses not only technological infrastructure, but also human capital, the competitiveness of the private sector and the accessibility of public services.

Table 3

TARGET INDICATORS FOR THE 'DIGITAL DECADE 2030' PROGRAMME BY AREA[37], [38]

Area	Targets by 2030
Digital skills	80% of citizens with basic digital skills; 20 million ICT professionals with gender balance
Digital infrastructure	Gigabit connectivity for all households; 5G coverage in all settlements; 10,000 edge computing nodes
Business digitalisation	75% of enterprises using the cloud, big data and AI; 90% of SMEs with a basic level of digital intensity
Digitalisation of public services	100% of key public services available online; 100% of citizens with access to electronic health records

The four areas are structurally interdependent — a lag in digital skills directly hinders the digitalisation of business and public services, whilst insufficient infrastructure development limits opportunities for the implementation of AI and cloud solutions. It is precisely this systematic approach that distinguishes the DDPP from sectoral strategies of previous years and makes it conceptually comparable to the architecture of the Green Deal.

The implementation of the DDPP's objectives is underpinned by a financial mobilisation unprecedented in the history of EU digital policy. The Recovery and Resil-

[36] Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030. Official Journal of the European Union. 2022. L 323. P. 4–26. CELEX:32022D2481. URL: https://eur-lex.europa.eu/eli/dec/2022/2481/oj

[37] European Commission. Europe's Digital Decade. https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade

[38] Eurostat. Towards Digital Decade targets for Europe. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Towards_Digital_Decade_targets_for_Europe

ience Facility (RRF), with a total budget of EUR672.5 billion, requires Member States to allocate at least 20 per cent of funds to the digital transition — amounting to a total of EUR134 billion in direct investment. In parallel, the Digital Europe Programme (DIGITAL), with a budget of EUR8.1 billion for 2021–2027, provides strategic investment in supercomputing, artificial intelligence, cybersecurity and digital skills[39]. The main financial instruments for the digital transition are summarised in Table 4.

Table 4

MAIN FINANCIAL INSTRUMENTS FOR THE EU'S DIGITAL TRANSITION[40], [41]

Instrument	Volume	Key funding areas
RRF — digital component (min. 20%)	up to EUR134 billion	Digitalisation of public services, AI, infrastructure
Digital Europe Programme (DIGITAL)	EUR8.1 billion (2021–2027)	AI, supercomputing, cybersecurity, skills
Horizon Europe — AI component	EUR1+ billion/year	AI research and innovation
AI Innovation Package (generative AI)	up to EUR4 billion (2024–2027)	Generative AI in strategic sectors
Member States' national roadmaps	EUR288.6 billion	All four DDPP strands

The total volume of public investment envisaged by these instruments alone exceeds EUR430 billion, demonstrating the unprecedented financial commitment to the EU's digital agenda. Crucially, the RRF simultaneously obliges Member States to allocate at least 37 per cent of funds to the green transition, transforming this mechanism into a structural instrument for coordinating both transitions — not merely at the level of declarations, but also at the level of budgetary commitments[42]. This is one of the few examples of operational, rather than merely rhetorical, integration of the green and digital transitions in EU practice.

The report 'State of the Digital Decade 2025' allows us to assess the current state of implementation of these commitments, noting mixed but generally positive trends. A key institutional achievement of 2024 is that all 27 Member States have, for the first time, adopted national roadmaps for digital transformation with a total budget of EUR288.6 billion — this signals a shift from strategic planning to practical imple-

[39] EURAXESS. Roundup on the EU's green and digital twin transition. https://euraxess.ec.europa.eu/worldwide/china/news/roundup-eu-green-and-digital-twin-transition

[40] European Commission. European approach to AI. https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

[41] European Commission. State of the Digital Decade 2025. https://digital-strategy.ec.europa.eu/en/library/state-digital-decade-2025-report

[42] European Commission. European approach to artificial intelligence. Shaping Europe's digital future. URL: https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

mentation[43]. The current status of progress towards the targets across the four areas is shown in Table 5.

Table 5

PROGRESS TOWARDS ACHIEVING THE TARGETS OF THE 'DIGITAL DECADE 2030' AS OF 2024–2025[44]; [45]

Area / indicator	2030 Target	Status in 2024	Progress assessment
Basic digital skills of citizens	80%	55.6%	⚠ Progress is being made, but needs to be accelerated
ICT professionals	20 million	10.3 million (steady growth)	⚠ Positive trend, but a significant gap remains
Women among ICT professionals	gender balance	19.5%	✗ Structural gap
SMEs with basic digital intensity	90%	73%	⚠ Gap is narrowing
Business adoption of AI, cloud and big data	75%	Growth below target	⚠ Acceleration required
Basic 5G coverage	100% of settlements	Significant expansion	⚠ Stand-alone networks are lagging behind
Deployment of edge nodes[46]	10,000	Active deployment	✓ On track
Digitisation of public services	100% online	Steady progress	✓ One of the most successful areas

Analysis of the data presented allows us to formulate three key observations. Firstly, the most successful areas are the digitalisation of public services and the deployment of edge computing nodes — both are on track to meet the 2030 targets, confirming the effectiveness of state-led investment models. Secondly, digital skills remain the most problematic area: the figure of 55.6 per cent against a target of 80 per cent reflects not merely a delay in time, but a deeper gap between the pace of the economy's digitalisation and the pace of human capital adaptation. At the same time,

[43] European Commission. State of the Digital Decade 2025. https://digital-strategy.ec.europa.eu/en/library/state-digital-decade-2025-report

[44] European Commission. 2025 State of the Digital Decade package. https://digital-strategy.ec.europa.eu/en/policies/2025-state-digital-decade-package

[45] Eurostat. Towards Digital Decade targets for Europe. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Towards_Digital_Decade_targets_for_Europe

[46] *edge nodes* — peripheral computing nodes (in telecommunications infrastructure/networks) that process data at the network's periphery, reducing latency and energy consumption *(ed.).*

the number of ICT professionals is steadily increasing — from 9.4 million in 2022 to 10.3 million in 2024 — which indicates real, albeit insufficient, progress[47]. Thirdly, the 2025 report systematically identifies, for the first time, dependence on external suppliers in the fields of artificial intelligence, cloud services and semiconductors as a distinct strategic risk — not only for digital competitiveness, but also for the green transition, as these technologies are key instruments for the decarbonisation of industry and energy[48]. Thus, despite significant progress in certain areas, the EU's digital transition faces the same systemic challenges as the green transition: disparities between Member States, a shortage of skilled workers and dependence on external technology suppliers. This indicates that both transitions not only reinforce each other but also share common structural obstacles — overcoming which requires coordinated, rather than parallel, policy at EU level.

Synergies and systemic risks of the dual transition

The conceptual assertion that the green and digital transitions reinforce each other takes on concrete meaning through a series of measurable mechanisms. According to European Commission estimates, digital technologies have the potential to reduce global CO_2 emissions in other sectors by 20 per cent by 2030 — primarily through improved energy efficiency in manufacturing, transport and construction. Specific examples illustrate the scale of this potential: extending the lifespan of smartphones by just one year would save 2.1 Mt of CO_2 per year by 2030; the transition from 4G to 5G networks could reduce the telecommunications sector's electricity consumption by up to 90 per cent[49]. These figures are not predictive assumptions, but calculations by the European Commission that form the basis for specific regulatory obligations.

The key regulatory instrument that brings about the synergy between both transitions at the legislative level is the Artificial Intelligence Act (AI Act, EU Regulation 2024/1689), which came into force on 1 August 2024 and became the world's first comprehensive legal framework for artificial intelligence[50]. Its significance for the dual transition is twofold: firstly, it provides regulatory certainty for AI systems that support decarbonisation — from managing smart grids and optimising industrial processes to precision farming and emissions monitoring; secondly, by establishing uniform requirements for AI transparency and safety, it lowers the barriers to the implementation of these solutions in the green sector. In parallel, the European Commission is building an institutional infrastructure for synergy through two complementary initiatives — the European Green Digital Coalition, which brings together companies with voluntary commitments to ad-

[47] Ibid.

[48] European Commission. 2025 State of the Digital Decade package. https://digital-strategy.ec.europa.eu/en/policies/2025-state-digital-decade-package

[49] European Commission. Green digital sector. https://digital-strategy.ec.europa.eu/en/policies/green-digital

[50] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act). Official Journal of the European Union. 2024. L series. CELEX:32024R1689. URL: https://eur-lex.europa.eu/eli/reg/2024/1689/oj

vance both transitions simultaneously, and the 'Destination Earth' initiative — a high-precision digital model of the Earth for climate forecasting and scenario analysis[51]. Both initiatives confirm a fundamentally important conclusion: the synergy between the green and digital transitions does not arise automatically — it requires targeted institutional, regulatory and investment efforts.

Alongside the potential for synergy, the simultaneous advancement of the two transitions gives rise to a number of systemic risks that require separate analytical consideration. The most acute of these is the shortage of skilled personnel, which affects both transitions simultaneously. The number of ICT professionals in the EU in 2024 stood at 10.3 million, with a target of 20 million by 2030 — meaning that the available workforce is less than half of what is required. This shortage reflects not merely a quantitative problem, but a structural gap between the pace of the economy's technological transformation and the pace of adaptation of education systems and the labour market. The skills shortage takes on an additional dimension due to gender inequality, which is a cross-cutting issue for both transitions. Women account for only 19.5 per cent of those employed in the ICT sector in the EU and are under-represented in green sectors. The economic consequences of this gap are concrete and measurable: according to European Commission estimates, as early as 2018 the EU economy lost EUR16.2 billion in productivity because women were leaving digital jobs[52]. This means that inclusion policies are not an optional add-on to transition strategies, but a necessary component — without which achieving quantitative targets is structurally impossible.

The third systemic risk is the uneven progress across Member States, which threatens the internal integrity of the single market. The 'State of the Digital Decade 2025' report highlighted significant disparities: 60 per cent of all electric vehicle charging stations are concentrated in just three countries — Germany, France and the Netherlands — which directly contradicts the goal of ensuring carbon-neutral mobility across the entire Union. Only six Member States are on track to meet the ESR targets with current measures, whilst 17 out of 27 countries will need to use flexibility mechanisms to meet the annual limits[53].

The risks considered do not exist in isolation — they reinforce one another. A shortage of skilled workers in less developed regions slows down digitalisation, which in turn limits the deployment of green technologies; the gender gap reduces the available workforce for both transitions simultaneously. This means that any risk left unaddressed automatically complicates the resolution of the others. That is why overcoming these challenges requires not separate sectoral measures, but a single coordinated policy that treats the green and digital transitions as an integrated system, rather than two parallel processes.

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[51] European Commission. Green digital sector. https://digital-strategy.ec.europa.eu/en/policies/green-digital

[52] Giesemann, Elisabeth. «The Future of Work in the Twin Transition to Green and Digital.» Originally published in *System Updates: Resetting the Future of Work*. BFNA, 2023. https://assets.ctfassets.net/9vgcz0fppkl3/3XO2r9DncF2OBXmq3yMYfJ/6316350091fe225fe38907a68cc96444/25012024_-2.pdf

[53] European Commission. 2025 State of the Digital Decade package. https://digital-strategy.ec.europa.eu/en/policies/2025-state-digital-decade-package

Conclusions

The conceptual evolution of the dual transition has progressed from the declaration of the interconnection between the green and digital transitions in the Green Deal (2019) and the Industrial Strategy (2020) to its critical rethinking in the European Commission's 2022 Strategic Foresight Report, which for the first time systematically documented not only the synergies but also the competition between the two transitions for limited investment, regulatory and human resources. The dual transition is not a mechanical combination of two autonomous strategies, but a systemic challenge, the success of which is determined by the level of their practical coordination in terms of regulatory instruments, financial mechanisms and institutional governance.

In the field of the green transition, the EU has established a regulatory framework of unprecedented scope: the legally binding climate targets of the Climate Act, the 'Fit for 55' package (adopted in full in 2023) and the draft target of a 90 per cent reduction by 2040 have ensured the institutional irreversibility of the course. Empirical results confirm the possibility of combining economic growth with decarbonisation — a 39 per cent reduction in emissions from 1990 levels alongside 71 per cent GDP growth. At the same time, structural lag remains critical in the ESR sectors — transport (+1 per cent in 2024), construction (stagnation) and agriculture — which generate over 65 per cent of emissions and require deep digitalisation as an integral component of decarbonisation.

The digital transition is being implemented through the 'Digital Decade 2030' programme — a first-of-its-kind strategy with measurable targets across four areas, backed by total public funding of over EUR430 billion through the RRF, the Digital Europe Programme and the national roadmaps of the 27 Member States. The human dimension remains the most problematic: only 55.6 per cent of citizens have basic digital skills (target: 80 per cent), 10.3 million ICT professionals compared to the target of 20 million, and 19.5 per cent of women in the ICT sector. The 'State of the Digital Decade 2025' report systematically identifies, for the first time, the EU's dependence on external suppliers of AI, cloud services and semiconductors as a strategic risk not only to digital competitiveness but also to the green transition.

The synergy between the two transitions is achieved through specific regulatory instruments — primarily the Artificial Intelligence Act (Regulation 2024/1689), which provides a legal framework for AI-driven decarbonisation systems, as well as through the Green Digital Coalition and the Destination Earth initiative. At the same time, advancing both transitions simultaneously creates systemic risks: a shortage of skilled workers (10.3 million versus 20 million), gender inequality (a EUR16.2 billion loss in productivity), and uneven progress across Member States (60 per cent of electric vehicle charging stations are in just 3 countries; 17 out of 27 Member States will require ESR flexibility mechanisms). The energy footprint of the digital sector — 8-10 per cent of the EU's final energy consumption, with data centres projected to grow from 70 to 115 TWh by 2030 — creates a structural barrier to scaling up key digital technologies.

Institutional developments in 2024–2025 — The Artificial Intelligence Act, the Omnibus Package, and the Stop the Clock Directive — signal a shift in European pol-

icy from a phase of ‘linear escalation of commitments’ to a phase of ‘pragmatic pace adjustment’ amid geopolitical turbulence, an energy crisis, and competitive pressure from the US and China. This transition does not mean abandoning the goals of the Green Deal — the legally binding targets of the Climate Act remain unchanged — but it shifts the instrumental logic of implementation towards a focus on key mechanisms (CBAM, AI Act, ETS). Further research should focus on analysing the implementation of the dual transformation concept by EU candidate countries, in particular Ukraine, in the context of post-war recovery and the alignment of national legislation with the EU *acquis communautaire* under new, pragmatically adjusted conditions.

*This article was translated from its original in Ukrainian.

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