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Digital and Green:
Reconciling the EU Twin Transitions in Times of War and Energy Crisis

Edoardo Celeste and Goran Dominioni*

Abstract: The Next Generation EU plan has significantly invested into the digital and green transitions to increase the resilience and boost the recovery of the European Union after the Covid-19 pandemic. The recent geopolitical developments following the Russian invasion of Ukraine have provoked an energy crisis in the EU. This chapter aims to analyse the EU strategic plans for the 'twin' - digital and green - transitions in such a complex post-pandemic context. Digitalisation can be a powerful driver of the green transformation thanks to its potential to help societal actors manage resources and infrastructures more efficiently. However, fostering a digital Europe cannot occur without climate considerations, due to environmental impact of digital technologies on energy consumption and raw materials. While EU digital sovereignty ambitions seem to be undermined by the current geopolitical situation, the ongoing energy crisis generate both positive and negative effects on EU decarbonisation strategies. Greater integration between the digital and green agendas can help deliver on both transitions.

Keywords: Next Generation EU, twin transitions, digitalisation, decarbonisation, energy crisis, war.

1. Introduction

Every cloud has a silver lining, and this proverb seems to hold true also in the context of the recent Covid-19 pandemic. Since March 2020, Europe has experienced one of the worst socio-economic crises from the end of World War II, more recently amplified by a stark rise of inflation and a related energy crisis generated by the Russian invasion of Ukraine. Yet, the Covid-19 pandemic has allowed the European Union (EU) to plan and introduce Next Generation EU (hereinafter NGEU), an unprecedented economic initiative, given its massive size and breadth of ambitions.[1] This new 'Marshall Plan' indeed allowed the EU to raise 800 billion Euro on the financial markets, thus creating a fiscal capacity that the EU Commission can administer independently from member states' contributions.[2]

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[1] Federico Fabbrini, 'The Legal Architecture of the Economic Responses to COVID-19: EMU beyond the Pandemic' (2022) 60 JCMS: Journal of Common Market Studies 186, 195.

[2] Fabbrini (n 1); Simonas Algirdas Spurga and Šreiberytė, Emilė, *Joint Debt Arrangements in EMU: From NextGenEU to Eurobonds* (Lietuvos Bankas 2021); Caroline de la Porte and Mads Dagnis Jensen, 'The next Generation EU: An Analysis of the Dimensions of Conflict behind the Deal' (2021) 55 Social Policy & Administration 388, 393.

NGEU's motto 'for a greener, more digital and resilient future' well encapsules the strategic objectives of this unprecedented economic measure.[3] Europe aims to recover from the pandemic and foster its economic growth, strengthening at the same time its resilience to climate, energy, health, and digital threats. The recipe to achieve these aims is not new per se.[4] Yet, climate change mitigation and digitalisation are proposed as the two guiding stars of this plan of economic recovery.[5] 37% of the NGEU funding is allocated to programmes and initiatives fostering the green transition, while 20% supports digitalisation.[6] Member states have the possibility to propose their own strategy on how to invest these funds at national level.[7] The EU distributes this funding through grants or loans to the member states.[8]

The NGEU recovery plan supports European member states to achieve digital and green transition together. However, the recent geopolitical tensions following the Russian invasion of Ukraine have provoked an unprecedented energy crisis in the EU, which is now affecting the EU economies and potentially undermining pre-established plans and objectives. For instance, due to the shortage of Russian oil and gas, EU member states have resorted to alternative sources of energy, often reopening old coal-fired power plants.[9] Tech companies and big public digital infrastructures are on the alert due to their high level of energy consumption, in particular those relying on servers located in the EU.[10]

This chapter aims to analyse the EU strategic plan for digital and green transition in the complex post-pandemic context that witnesses, on the one hand, unprecedented investments thanks to the NGEU programme, and, on the other hand, new challenges due to the current geopolitical situation. The chapter argues that greater integration between the digital and green EU agendas is needed to harness synergies and deliver on both transitions.

The chapter is structured as follows: Section 2 analyses the main aims of the digital and green transition in the EU, focusing in particular on the impact of the NGEU plan. Section 3 assesses to what extent the digital and green transitions effectively represent twin transformations to be addressed in a joint and complementary way by the EU. We will highlight in particular the

[3] Directorate-General for Budget (European Commission), *EU Budget Policy Brief: The EU as an Issuer : The NextGenerationEU Transformation. #3, July 2022* (Publications Office of the European Union 2022) <https://data.europa.eu/doi/10.2761/111076> 4.

[4] Klaus Armingeon and others, 'Voices from the Past: Economic and Political Vulnerabilities in the Making of next Generation EU' (2022) 20 Comparative European Politics 144, 145.

[5] See Claire Dupont, Sebastian Oberthür and Ingmar von Homeyer, 'The Covid-19 Crisis: A Critical Juncture for EU Climate Policy Development?' (2020) 42 Journal of European Integration 1095, 1102.

[6] Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility, art. 16.

[7] Zeitlin, J., (2024) National Recovery & Resilience Plans, in Federico Fabbrini and Christy A. Petit (eds), Research Handbook on Post-Pandemic EU Economic Governance & NGEU Law (Edward Elgar 2024).

[8] Matos, N. (2024) Covid-19 & Economic Union, , in Federico Fabbrini and Christy A. Petit (eds), Research Handbook on Post-Pandemic EU Economic Governance & NGEU Law (Edward Elgar 2024).

[9] Dezem, V., 2022, Germany Bolsters Coal-Fired Power to Meet Winter Power Demand, Bloomberg, <https://www.bloomberg.com/news/articles/2022-10-21/germany-bolsters-coal-fired-power-to-meet-winter-power-demand?leadSource=uverify%20wall>.

[10] April Roach and Ewa Krukowska, 'Big Tech Gets Caught Up in Europe's Energy Politics' *Bloomberg.com* (23 June 2022) <https://www.bloomberg.com/news/articles/2022-06-23/google-facebook-data-centers-face-europe-political-snags-over-in-energy-crisis>.

Janus-faced role played by digitalisation vis-à-vis decarbonisation strategies. Section 4 examines whether the current geopolitical situation is putting EU plans in the digital and green field at risk. While the ambitious objectives of the EU to regain its digital sovereignty seem to be undermined, we contend that the current energy crisis generate both positive and negative effects on EU decarbonisation strategies. Section 5, finally, concludes stressing the need to adopt a holistic and more integrated vision of digital and green policies in order to successfully achieve both transitions in the EU, instead of continuing developing them independently.

2. The Digital and Climate Transitions and the NGEU Plan

2.1 The NGEU boost to the EU digital agenda

Before the recent promotion of digitalisation as a joint component of the EU policy strategy together with climate change action, the digital transformation represented a stand-alone EU policy cluster with its own agenda. The first EU comprehensive policy instrument in the field of digitalisation was the 2010 Digital Agenda for Europe.[11] 2020 marked the introduction of a second digital agenda for Europe, listing policy objectives for what has been called the 'Digital Decade', i.e. the years from 2020 to 2030.[12]

Further complemented by the EU Commission's communications Forging Europe's digital future[13], Europe's digital decade[14] and EU Digital Compass,[15] the new agenda stresses the crucial role played by digital technology not only as an instrument to foster the EU internal market but also to help Europe to achieve its economic and geopolitical aspirations as a global leader in the digital field. This phase clearly sees the emergence of the defence of EU digital sovereignty as a key policy objective to compete against the superpower of US and Chinese tech firms and at the same time preserve EU fundamental rights and liberties.[16] To this end, the second EU digital agenda stresses the importance of investing in a human-centric form of artificial intelligence that preserves fundamental rights, developing EU digital infrastructures including supercomputing facilities, enhancing the cybersecurity of the whole chain of EU digital systems, ensuring high levels of connectivity through fast broadband, 5G and 6G technologies, as well as controlling the use of semiconductors which are necessary to make chips. The metaphor of the digital 'compass' is also introduced to visually identify the four main policy aims of the second agenda, namely: the development of digital skills, the

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[11] European Commission, A Digital Agenda for Europe [COM(2010)245 final].

[12] European Commission, 2030 Policy Programme "Path to the Digital Decade" [COM(2021) 574 final], para 3.

[13] European Commission. Directorate General for Communications Networks, Content and Technology, Shaping Europe's Digital Future. (Publications Office 2020) <https://data.europa.eu/doi/10.2759/091014>.

[14] European Commission (n 13).

[15] European Commission, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions - 2030 Digital Compass: the European Way For The Digital Decade 2021 [COM(2021) 118 final].

[16] See Edoardo Celeste, 'Digital Sovereignty in the EU: Challenges and Future Perspectives' in Federico Fabbrini, Edoardo Celeste and John Quinn (eds), *Data Protection Beyond Borders: Transatlantic Perspectives on Extraterritoriality and Sovereignty* (Hart 2021).

digitalisation of businesses, the implementation of secure digital infrastructures and the digitalisation of public services also by fostering the use of digital identities.

The NGEU plan adopted in 2020 does not represent a further policy strategy per se but rather a financial booster of exceptional nature. NGEU has a twofold objective: on the one hand, it aims to restore the socio-economic damages generated by the Covid-19 pandemic and to create resilience against potential similar future challenges; on the other hand, it is a one-off instrument to inject liquidity in the EU long-term budget to pursue already established policies. In this sense, NGEU offers EU member states the possibility to accelerate their national digitalisation plans thanks to a combination of grants, loans and financial support to research in this field. The core instrument of NGEU is the Recovery and Resilience Facility (RRF), which aims to provide funding to make the EU greener, more digital and more resilient vis-à-vis present and future challenges.[17] The digital transformation is one of the six areas of EU policy relevance that are supported by the RFF, and together with the green transition represents one of the most transversal policy objectives, as it informs other policy areas such as for instance the aim of fostering an inclusive economic growth, education, health and social and territorial cohesion.[18]

NGEU also provides funding to Horizon Europe and the European research and innovation programme.[19] With a budget of approximately 95.5 billion Euro over six years (2021-2027), Horizon Europe will promote research and innovation in the digital field, also in partnership with the industry sector. Moreover, in 2021 the EU Commission created a further instrument that complements the investment into digital research and innovation promoted by Horizon Europe by setting up the Digital Europe Programme (DIGITAL).[20] DIGITAL represents the first thematic funding instrument focusing on areas considered of strategic importance for the EU in the field of digitalisation.[21] It identifies five interrelated specific areas of investment: supercomputing, artificial intelligence, cybersecurity, digital skills, digital capacity and interoperability.[22] The ultimate aim of the programme is not only to effectively achieve the digital transformation in the EU, thus benefiting citizens, businesses and public administrations, but also to preserve EU sovereignty in the digital field by promoting its global competitiveness and thus its strategic autonomy.[23]

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[17] European Commission. Directorate General for Economic and Financial Affairs., *Quantifying Spillovers of next Generation EU Investment.* (Publications Office 2021), <https://data.europa.eu/doi/10.2765/80561>.

[18] European Commission, Review report on the implementation of the Recovery and Resilience Facility [COM(2022) 383 final].

[19] Directorate-General for Research and Innovation (European Commission), *Horizon Europe, the EU Research and Innovation Programme (2021-27): For a Green, Healthy, Digital and Inclusive Europe* (Publications Office of the European Union 2021) <https://data.europa.eu/doi/10.2777/052084>.

[20] Regulation (EU) 2021/694 of the European Parliament and of the Council of 29 April 2021 establishing the Digital Europe Programme and repealing Decision (EU) 2015/2240.

[21] Marcin Szczepanski, 'Digital Europe Programme: Funding Digital Transformation beyond 2020' [2021] European Parliamentary Research Service <https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/628231/EPRS_BRI(2018)628231_EN.pdf>.

[22] Regulation (EU) 2021/694, Article 2.

[23] Regulation (EU) 2021/694, Article 2.

In 2022, the EU Commission, Parliament and Council solemnly adopted the *European Declaration on Digital Rights and Principles for the Digital Decade*.[24] This instrument is not legally binding but articulates the EU vision on fundamental rights and principles for the digital society. The declaration explicitly focuses on 'sustainability' as one of the main aims of the digital transformation.[25]

2.2 EU decarbonisation targets and green investments under NGEU

The European Union has long been at the forefront of climate change action among large emitters. In 2019, the EU bolstered its climate change mitigation commitments by agreeing to make the EU climate-neutral by 2050. EU member states agreed to reduce their greenhouse gas (GHG) emissions significantly by 2050 while finding ways to offset residual GHG emissions to reach a balance of net-zero GHG emissions overall.[26] The 2050 goal has been complemented with an interim target of reducing GHG emissions by at least 55 percent by 2030 over 1990 levels.[27] In 2021, both targets were enshrined in the European climate law, which makes them legally binding.[28]

To meet the 2030 GHG mitigation targets, the EU has planned a series of reforms across various sectors of the economy — the so-called 'Fit for 55 package'.[29] Core aspects of the package include a revision of the EU emission allowance trading system (ETS) to increase its stringency, improve its functioning, and broaden its application to other sectors. At the time of writing, several reforms have been adopted. These include the adoption of a carbon border adjustment mechanism to address policy-induced carbon leakage,[30] and the inclusion of international maritime transport into the EU ETS.[31] In the package, the ambition in sectors

[24] European Commission, *European Declaration on Digital Rights and Principles for the Digital Decade* (2022). See Edoardo Celeste, 'Digital Constitutionalism, EU Digital Sovereignty Ambitions and the Role of the European Declaration on Digital Rights' in Annegret Engel, Xavier Groussot and Gunnar Thor Petursson (eds), *New Directions in Digitalisation: Perspectives from EU Competition Law and the Charter of Fundamental Rights* (Springer 2024).

[25] See Alba Perez, Edoardo Celeste and Alberto Quintavalla, 'Greening AI? The new principle of sustainable digital products and services in the EU' (forthcoming 2024).

[26] Council of the European Union, Climate change: what the EU is doing, <https://www.consilium.europa.eu/en/policies/climate-change/#2030> last accessed 03-01-2023.

[27] ibid.

[28] ibid.

[29] Council of the European Union, 2023, Fit for 55: a fund to support the most affected citizens and businesses <https://www.consilium.europa.eu/en/infographics/fit-for-55-social-climate-fund/>.

[30] Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism. Policy-induced carbon leakage refers to the displacement of GHG-emitting activities and investments to climate-laggard jurisdictions in response to adopting more stringent GHG policies in another jurisdiction. On this, see Dominioni, G., & Esty, D. C. (2023). Designing Effective Border-Carbon Adjustment Mechanisms: Aligning the Global Trade and Climate Change Regimes. Arizona Law Review, (65), 1.

[31] Regulation (EU) 2023/957 of the European Parliament and of the Council of 10 May 2023 amending Regulation (EU) 2015/757 in order to provide for the inclusion of maritime transport activities in the EU Emissions Trading System and for the monitoring, reporting and verification of emissions of additional greenhouse gases and emissions from additional ship types, PE/10/2023/REV/.

covered by the EU ETS is coupled with the strengthening of the effort-sharing regulation and the regulation on land use, land use change, and forestry (LULUCF). For instance, EU institutions have revised the effort-sharing regulation, tightening its stringency significantly.[32] A provisional agreement between the Council and the European Parliament has also been achieved concerning the LULUCF regulation.[33]

The EU has also pledged to mobilise at least 1 trillion euros in green investments over the next decade.[34] A core component of this mobilisation effort relates to EU public financing, as a significant share of the EU's budget for the period 2021-2028 and the NGEU are reserved for green investments. This public financing is expected to mobilize additional private green investments. EU member states are expected to devote at least 37 percent of the funding received through the RRF to support the achievement of climate objectives. The NGEU component will largely be financed through the emission of green bonds. Proceeds are expected to be invested in various green activities, including financing energy efficiency improvements and the deployment of clean energy.[35]

3. Digital and Green: Twin Transitions?

3.1 The Janus-faced role of the digital transformation

Digitalisation and decarbonisation are seen as 'twin transitions'.[36] Twin not only in the sense that are occurring at the same time, but also advocating an integration of the two: digitalisation for decarbonisation and decarbonisation of digitalisation. Indeed, digitalisation possesses a Janus-faced role vis-à-vis the green transition: it can be difficult to achieve efficient decarbonisation without the help of digital technologies, but digital technologies do have environmental implications and their increasingly massive use enhance energy consumption and has an impact of the exploitation of natural resources. In this section, we will analyse in particular three core elements of the digital transformation: data centres, artificial intelligence (AI) and digital twins.

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[32] Regulation (EU) 2023/857 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, and Regulation (EU) 2018/1999 PE/72/2022/REV/1OJ L 111.

[33] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU.

[34] European Commission, Finance and the Green Deal, 2022, <https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal_en>.

[35] European Commission, NGEU Green Bonds, <https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu-green-bonds_en>.

[36] See Joint Research Centre (European Commission) and others, *Towards a Green & Digital Future: Key Requirements for Successful Twin Transitions in the European Union* (Publications Office of the European Union 2022) <https://data.europa.eu/doi/10.2760/977331> 7.

Data centres are the physical infrastructure at the basis of cloud computing.[37] They are key to the digital society due to the increased use of shared online services hosted on the cloud.[38] These centres are essential to store and process the data of the services we use online as well as to provide network equipment for communication. They also allow for increased cybersecurity and help businesses become more digital and efficient. Their role has been made even more apparent during the Covid-19 pandemic when people made significant use of online services and increasingly worked from home.

Data centres use less energy if compared to a set of single on-premises servers performing the same tasks.[39] Moreover, they help reduce carbon emissions related to commuting as they enable remote working.[40] By relying on services supported by data centres, businesses can streamline their operations and reduce their associated GHG emissions.[41] Data centres are also global leaders in the use of renewable energies and can supply carbon-neutral heating to surrounding areas.[42] Large tech companies pledge to adhere to strict environmental and climate standards. Some argue to be even carbon neutral or having limited their environmental impact, for example thanks to their reduced water consumption and high reliance on renewable energy sources.[43] It appears that data centres are among the most efficient big energy consumers, thanks to the advanced technologies used.[44] Recently, data centres' operators have proposed a voluntary code of conduct called Data Centres Energy Efficiency, which aims to reduce energy consumption while preserving data centre's performance.[45] This happened in the context of a

[37] Claudio Fiandrino and others, 'Performance and Energy Efficiency Metrics for Communication Systems of Cloud Computing Data Centers' (2017) 5 IEEE Transactions on Cloud Computing 738.

[38] See Edoardo Celeste and Federico Fabbrini, 'Competing Jurisdictions: Data Privacy Across the Borders' in Grace Fox, Theo Lynn and Lisa van der Werff (eds), *Data Privacy and Trust in Cloud Computing* (Palgrave 2020).

[39] See Baringa, 'Green Data: A Vision for Sustainable Data Centres in Ireland' (Baringa Partners LLP 2022); S&P Global Market Intelligence and Kelly Morgan, Black & White | Saving Energy in Europe by Using Amazon Web Services <https://d39w7f4ix9f5s9.cloudfront.net/d1/80/283b833847df8ee4fe9661e0dd8f/11061-aws-451research-advisory-bw-cloudefficiency-eu-2021-r2-final-2.pdf>.

[40] See Baringa (n 46).

[41] See Hatem Tamimi and Ameur Bensefia, 'Factors Influencing Green Data Centers in UAE', 2018 Advances in Science and Engineering Technology International Conferences (ASET) (2018).

[42] Pei Huang and others, 'A Review of Data Centers as Prosumers in District Energy Systems: Renewable Energy Integration and Waste Heat Reuse for District Heating' (2020) 258 Applied Energy 114109; Reuters, 'Microsoft Data Centres to Heat Finnish Homes, Cutting Emissions' Reuters (17 March 2022) <https://www.reuters.com/business/sustainable-business/microsoft-data-centres-heat-finnish-homes-cutting-emissions-2022-03-17/>.

[43] Roach and Krukowska, (n 10)

[44] Dan Wellers and Christopher Koch, 'Blockchain's Energy Crisis' (*SAP Insights*, 11 June 2020) <https://insights.sap.com/blockchains-energy-crisis/>.

[45] BloombergNEF, Statkraft, and Eaton, 'Data Centers and Decarbonization: Unlocking Flexibility in Europe's Data Centers' (Bloomberg Finance LP 2021). <https://www.eaton.com/content/dam/eaton/company/news-insights/energy-transition/documents/bnef-eaton-statkraft-data-center-study-en-us.pdf>. See <https://www.eaton.com/gb/en-gb/company/news-insights/energy-transition/bnef-data-centres-and-decarbonisation-study.html?source=post:1427248746593282584>.

more ambitious plan of making data centres carbon neutral by 2030 as pledged in the Climate Neutral Data Centre Pact.[46]

AI technologies are regarded as an essential tool to promote the green transition.[47] In the short term, AI systems can identify and release underutilised energy resources for the benefit of the users and to lower the burden of the energy grid; help manage waste and enhance the circular economy.[48] In the long term, AI can also help integrate decentralised types of renewable energy into the grid, thus enhancing its flexibility and allowing for more diversification of energy sources and less risk of price volatility due to the anchoring of the energy price to one single source.[49] AI systems are pivotal to enable sustainable smart cities and smart mobility in line with the EU Green Deal objective of reducing by 90% carbon emissions of the transport sector within the next thirty years.[50] Always from a smart mobility perspective, AI will play a significant role in implementing effective multimodal transport systems and efficiently locate and identify recharging stations for zero emissions vehicles.[51]

Digital twins are 'digital representations' of a real product or process.[52] They can help create a computational model of industries or for product design in order to understand criticalities and make their processes more efficient, also from an environmental perspective.[53] These virtual simulations offer an accurate picture of likely scenarios based on precise operational choices linked to different energy consumption patterns. They allow testing which process offers the

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[46] See John Booth, 'Cleaner, Greener Data Centres' (2021) 63 ITNOW 18; M Saeed Misaghian and others, 'Assessment of Carbon-Aware Flexibility Measures from Data Centres Using Machine Learning' [2022] IEEE Transactions on Industry Applications 1.

[47] See Josh Cowls and others, 'The AI Gambit: Leveraging Artificial Intelligence to Combat Climate Change—Opportunities, Challenges, and Recommendations' [2021] Ai & Society 16. <https://doi.org/10.1007/s00146-021-01294-x>. Even if at regulatory level, with specific reference to the EU Commission's proposal of an AI Act, the EU has been criticised for not paying sufficient attention to negative environmental effects that AI may produce: see Ugo Pagallo, Jacopo Ciani Sciolla and Massimo Durante, 'The Environmental Challenges of AI in EU Law: Lessons Learned from the Artificial Intelligence Act (AIA) with Its Drawbacks' (2022) 16 Transforming Government: People, Process and Policy 359.

[48] See Rajan Jose and others, 'Artificial Intelligence-Driven Circular Economy as a Key Enabler for Sustainable Energy Management' (2020) 2 Materials Circular Economy 8; Matthew Wilson, Jeannette Paschen and Leyland Pitt, 'The Circular Economy Meets Artificial Intelligence (AI): Understanding the Opportunities of AI for Reverse Logistics' (2021) 33 Management of Environmental Quality: An International Journal 9.

[49] See European Commission, 'Questions and Answers: EU Action Plan on Digitalising the Energy System' (*European Commission - European Commission*, 18 October 2022) <https://ec.europa.eu/commission/presscorner/detail/en/QANDA_22_6229>.

[50] European Commission, The European Green Deal 2019 [COM/2019/640 final].

[51] ibid.

[52] David Jones and others, 'Characterising the Digital Twin: A Systematic Literature Review' (2020) 29 CIRP Journal of Manufacturing Science and Technology 36.

[53] Sin Yong Teng and others, 'Recent Advances on Industrial Data-Driven Energy Savings: Digital Twins and Infrastructures' (2021) 135 Renewable and Sustainable Energy Reviews 110208; Michael Grieves and John Vickers, 'Digital Twin: Mitigating Unpredictable, Undesirable Emergent Behavior in Complex Systems' in Franz-Josef Kahlen, Shannon Flumerfelt and Anabela Alves (eds), *Transdisciplinary Perspectives on Complex Systems* (Springer 2017); Fei Tao and others, 'Digital Twin-Driven Product Design Framework' (2019) 57 International Journal of Production Research 3935; Stéphane Rapoport and others, 'Digital Twins Offer Plant Operators Relief from Energy Crisis' (*ENGIE Impact*, 2022) <https://www.engieimpact.com/insights/digital-twins-energy>.

best balance between energy consumption and performance. The EU Commission itself seems to be planning the creation of an energy data space and a digital twin of the energy system.[54]

However, besides this potential for climate change mitigation, the digital transformation shows a Janus-faced attitude towards the green transition. Indeed, about 7% of the world's electricity is used by the ICT sector, a percentage that is expected to climb to 13% by 2030.[55] According to the EU Commission, only the use that individuals do by browsing the Internet, buying online and streaming movies accounted for 2.7% of the 2018 EU electricity consumption.[56] Currently, the energy footprint related to the use of digital technology tools accounts for 3-5% of the world's carbon emissions: interestingly, the same usage as the aviation sector, which is far more targeted by environmental activists and the media as one of the main sources of carbon emissions.[57]

In particular, data centres accounted for 2.7% of the overall EU electricity demand in 2018 and their consumption is expected to rise by 200% in the next decade.[58] In countries such as Ireland, with one of the highest concentrations of data centres, the energy consumption of these facilities could amount to 23% of the total nation-wide consumption by 2030.[59] In light of this, the EU Commission has announced the introduction of monitoring and reporting requirements for data centres' energy consumption, of an environmental labelling scheme and of an EU Code of Conduct for the sustainability of telecommunications networks.[60]

Another big energy consumer is blockchain technology. In simple terms, blockchain is a digital ledger that through a cryptographic mechanism is able to verify the existence and authenticity of transactions or operations.[61] Today blockchain represents the basic tool for cryptocurrencies but it is also currently considered for a broad range of activities, performed both by private and public entities, which require it to identify and authenticate transactions.[62] Blockchain is considered to be an energy 'guzzler'.[63] It has been estimated that the energy consumption of one Bitcoin transaction is equivalent to 100,000 transactions made with a standard VISA card.[64]

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[54] Luca Bertuzzi, 'LEAK: EU Prepares "action Plan" to Digitalise the Energy System' (*www.euractiv.com*, 14 September 2022) <https://www.euractiv.com/section/next-generation-infrastructure/news/leak-eu-prepares-action-plan-to-digitalise-the-energy-system/>.

[55] European Commission (n 56).

[56] ibid.

[57] ibid.

[58] ibid.

[59] April Roach and Ewa Krukowska, 'Big Tech Gets Caught Up in Europe's Energy Politics' *Bloomberg.com* (23 June 2022) <https://www.bloomberg.com/news/articles/2022-06-23/google-facebook-data-centers-face-europe-political-snags-over-in-energy-crisis>.

[60] European Commission (n 56).

[61] See Michael Nofer and others, 'Blockchain' (2017) 59 Business & Information Systems Engineering 183.

[62] See AI Pestunov, 'Cryptocurrencies and Blockchain: Potential Applications in Government and Business' (2020) 62 Problems of economic transition 286; Jei Young Lee, 'A Decentralized Token Economy: How Blockchain and Cryptocurrency Can Revolutionize Business' (2019) 62 Business Horizons 773; Syed S Ahmad, Shahzad Khan and Mohammad A Kamal, 'What Is Blockchain Technology and Its Significance in the Current Healthcare System? A Brief Insight' (2019) 25 Current Pharmaceutical Design 1402.

[63] Dan Wellers and Christopher Koch, 'Blockchain's Energy Crisis' (*SAP Insights*, 11 June 2020) <https://insights.sap.com/blockchains-energy-crisis/>.

[64] Wellers and Koch (n 70).

Such a high level of energy consumption is due to the so-called 'mining', the activity allowing blockchain computing systems to perform cryptographic activities and reach a consensus on the identity and authenticity of a transaction.[65] So far 'miners' have established their server farms mainly in areas with energy overplus, like Iceland and rural China.[66]

3.2 The EU decarbonization agenda and digitalization: Short vs long term impact

This section looks at the relationship between the EU decarbonization agenda and the digitalization of Europe. In particular, it first looks at how the decarbonization of Europe can support its digitalization in the short, medium, and long term and then considers potential clashes between the two.

As discussed in the previous section, digital technologies can help decarbonize the European economy, for instance, by allowing improved energy efficiency in the transportation and urban mobility sector,[67] to optimise home energy management systems[68] and industrial energy management.[69] The potential GHG benefits of adopting digital technologies imply that climate change mitigation policies can be a driver of digitalization in at least three ways.

First, GHG mitigation policies can help create a favourable business environment for deploying digital technologies. For instance, GHG policies that increase the cost of consuming fossil fuels — such as reforms of fossil fuel subsidies and carbon pricing instruments on fossil fuels or on goods and services produced consuming fossil fuels — can make the business case to invest in digital technologies that reduce energy consumption. Similarly, subsidies or tax credits for green investments can support the deployment of climate-related digital technologies, such as smart metres.

Second, GHG policies can help the diffusion of digital technologies through mandates. For instance, Norway has in the past mandated the adoption of smart metres[70] and Germany has

[65] See Jingming Li and others, 'Energy Consumption of Cryptocurrency Mining: A Study of Electricity Consumption in Mining Cryptocurrencies' (2019) 168 Energy 160; Wenbo Wang and others, 'A Survey on Consensus Mechanisms and Mining Strategy Management in Blockchain Networks' (2019) 7 IEEE Access 22328.

[66] Wellers and Koch (n 70).

[67] M. Taiebat, A.L. Brown, H.R. Safford, S. Qu, M. Xu, A review on energy, environmental, and sustainability implications of connected and automated vehicles, Environ Sci Technol (2018), 10.1021/acs.est.8b00127.

[68] IEA, Energy Efficiency 2019 (2019), <https://www.iea.org/reports/energy-efficiency-2019>.

[69] IBM, Cognitive manufacturing: an overview and four applications that are transforming manufacturing today, <https://www.ibm.com/downloads/cas/VDNKMWM6#:~:text=Four%20cognitive%20manufacturing%20applications%20are,optimization%20and%20supply%20chain%20optimization>.

[70] Geels, F W, Sareen, S, Hook, A and Sovacool, B K (2021) Navigating implementation dilemmas in technology-forcing policies: a comparative analysis of accelerated smart meter diffusion in the Netherlands, UK, Norway, and Portugal (2000-2019). Research Policy, 50 (7).

been reported to be considering the adoption of a similar rule for large and medium enterprises to speed up the adoption of smart metres in the country.[71]

Lastly, and relatedly, GHG policy can contribute indirectly to the diffusion of digital technologies by creating economies of scale for green technologies and indirectly support the digitalization of energy use and consumption. A classic example of this process was the adoption of a feed-in tariff program in Germany that supported the initial adoption of solar panels in the country. Notably, the German feed-in tariff program helped create the conditions for the large-scale production of solar panels in China.[72] The deployment of solar energy at a large scale is now a core component of the EU decarbonization agenda[73] as well as an integral part of the EU agenda for the digitalization of energy production and use.[74] For instance, smart grids and related data production are a core component of optimising solar energy use.[75] Thus public support for investments in green technologies can indirectly help the digitalization of the energy market.

In the mid-long term, the decarbonization of the EU economy may impact its energy security, which may affect the flourishing of a digital industry in the EU. As mentioned in the previous sub-section, some segments of the digital industry score high in energy consumption. The high demand for electricity from the sector can pose energy security concerns,[76] especially in countries where data centres account for an even larger share of domestic electricity consumption, such as Ireland.[77] At the same time, the relationship between the decarbonization of the EU and energy security in the region is unclear.[78] For instance, while reducing GHG emissions requires diversifying energy sources, including through the deployment of domestic renewable energy sources, it may also imply leaving underground some of the fossil fuel reserves available in the territories of EU Member States. There is, therefore, a potential conflict between the flourishing of important segments of the EU digital industry and the EU decarbonization agenda.

4. Impact of war and energy crisis on the EU twin transitions

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[71] Spencer Jones, J., Germany to make smart meters mandatory?, <https://www.smart-energy.com/industry-sectors/smart-meters/germany-to-make-smart-meters-mandatory/>.

[72] Nemet, G. F., *German demand-pull. How Solar Energy Became Cheap* (Routledge 2019).

[73] European Commission, Solar energy, 2022, <https://energy.ec.europa.eu/topics/renewable-energy/solar-energy_en#:~:text=EU%20Solar%20PV%20Industry%20Alliance&text=The%20Commission%20formally%20endorsed%20the,almost%20600%20GW%20by%202030>.

[74] European Commission (n 56).

[75] Baidya, S., Potdar, V., Ray, P. P., & Nandi, C. (2021). Reviewing the opportunities, challenges, and future directions for the digitalization of energy. *Energy Research & Social Science*, 81, 102243.

[76] Guo, C., Luo, F., Cai, Z., & Dong, Z. Y. (2021). Integrated energy systems of data centers and smart grids: State-of-the-art and future opportunities. *Applied Energy*, 301, 117474.

[77] For the case of Ireland, see Daly, H., Irish electricity and gas demand to 2050 in the context of climate commitments (Friends of the Earth 2022).

[78] Strambo, C., Nilsson, M., & Månsson, A. (2015). Coherent or inconsistent? Assessing energy security and climate policy interaction within the European Union. *Energy Research & Social Science*, 8.

4.1 Risks for the EU digital sovereignty ambitions

The Russian invasion of Ukraine recently exacerbated an energy crisis already started during the Covid-19 pandemic.[79] Prices of oil and gas – and consequently, of electricity – have skyrocketed as a reaction to the EU decision to limit trade with Russia in the context of a broad package of sanctions that the EU applied to Russia in light of the illegitimate nature of the war. In order to understand the entity of the current issue, it is useful to recall that the EU used to buy 40% of its gas from Russia and that member states' electricity production still relies heavily on fossil fuels.[80] Some EU member states have decided to reactivate old coal fired energy plants that were supposed to be phased out in 2022-2023 in order to compensate the shortage of gas.[81] Other measures included the reduction of energy consumption in private and public settings, such as street lighting, limited temperature in swimming pools and rationing of household's hot water supplies.[82] The EU Commission introduced a toolbox to face the challenges of the current energy crisis. It includes short term remedies for individuals and businesses such as income support and tax breaks.[83] However, the current situation has shown the need to work on longer term objectives, such as making the energy grid more efficient, integrating a mix of energy sources, from renewable to nuclear ones.[84] Yet, these objectives take significant time and require more research on how to achieve them.

The EU Commission sees digitalisation as a key element to contrast the energy crisis in the short term.[85] On the one hand, there is a certain optimism on the role of digital technologies in tackling these issues. The recent global pandemic has prompted the major investments outlined above that offer a unique chance to accelerate the process of digitalising the European economy and society. The Commission has also announced the creation of an energy label for computers that will expand the scope of the Ecodesign for Sustainable Goods Regulation to include new ICT products in order to encourage more energy efficient/reparable/reusable products.[86] On the other hand, the negative impact of the war and the current energy crisis on the EU digital agenda has still to be fully assessed.

[79] See Jan Osička and Filip Černoch, 'European Energy Politics after Ukraine: The Road Ahead' (2022) 91 Energy Research & Social Science 102757; Charalampos Basdekis and others, 'The Impact of the Ukrainian War on Stock and Energy Markets: A Wavelet Coherence Analysis' (2022) 15 Energies 8174.

[80] See Madina Khudaykulova, He Yuanqiong and Akmal Khudaykulov, 'Economic Consequences and Implications of the Ukraine-Russia War' (2022) 8 The International Journal Of Management Science And Business Administration 44,; Joe Wallace and Jenny Strasburg, 'Ukraine Reduced Russian Gas Flowing to Europe Through Key Pipeline' Wall Street Journal (11 May 2022) <https://www.wsj.com/articles/natural-gas-prices-rise-in-europe-after-ukraine-cuts-flows-11652255011>.

[81] Petre Prisecaru, 'European Green Deal and Energy Crisis in EU' (2021) 9 Global Economic Observer 27; Kate Connolly, 'Germany to Reactivate Coal Power Plants as Russia Curbs Gas Flow' *The Guardian* (8 July 2022) <https://www.theguardian.com/world/2022/jul/08/germany-reactivate-coal-power-plants-russia-curbs-gas-flow>; Markus Wacket and Riham Alkousaa, 'Germany Fires up Coal and Deepens Czech Ties as Gas Threat Looms' *Independent.ie* (12 July 2022) <https://www.independent.ie/business/world/germany-fires-up-coal-and-deepens-czech-ties-as-gas-threat-looms-41831732.html>.

[82] Connolly (n 89).

[83] Prisecaru (n 89).

[84] Prisecaru (n 89).

[85] European Commission (n 56).

[86] ibid.

Tech companies and public actors managing major digital infrastructures are on the alert due to their high level of energy consumption, in particular those relying on servers located in the EU. A climate of incertitude and anxiety emerges in this context due to the appeal made to member states to reduce their energy consumption and the possibility of blackouts caused by shortage of electricity during peak times. The current energy crisis also changed the short-term political priorities of various member states. For examples, two pharaonic projects for the Google's 1.1 billion data centre in Luxembourg and the even bigger Meta's one in the Netherlands have been put on hold -- partially because of neighbours' opposition and environmental activists' advocacy, but also due to the current energy crisis that sees increased costs and potential shortage of electricity at national level.[87] In light of this situation, on 27th June 2022, EU energy ministers agreed to introduce common standards to regulate energy consumption of big data centres.[88] At the moment, indeed, there are no detailed legal obligations regulating energy consumption by data centres in Europe.[89] The dilemma that afflicts this operation lies in the balancing between the necessary short term reduction of energy consumption – or speaking more in the long term, decarbonisation – and the objective of making Europe a global leader in the digital field and preserving its digital sovereignty.[90]

From this point of view, the EU digitalisation and innovation strategies are put under stress by the current energy crisis. Increasing cybersecurity risks emerge due to potential energy cuts to big energy consuming critical infrastructures, a circumstance even more dangerous in a context of widespread cyberattacks and cyberwarfare characterising the war in Ukraine.[91] The political decision of sacrificing citizens' needs to keep data centres or major computing systems on would be extremely unpopular. Innovation in the digital sector might slow down due to rising energy costs burning available financial resources more quickly. This directly impacts the EU's commitment to become a world leader in the tech sector and achieve a status of 'digital autarchy' emancipating itself from the dependence and influence of foreign digital superpower,

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[87] April Roach and Ewa Krukowska, 'Big Tech Gets Caught Up in Europe's Energy Politics' *Bloomberg.com* (23 June 2022) <https://www.bloomberg.com/news/articles/2022-06-23/google-facebook-data-centers-face-europe-political-snags-over-in-energy-crisis>.

[88] Council of the European Union, Proposal for a directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652 2022. See also Pieter Haeck and Antonia Zimmermann, 'Europe's Hidden Energy Crisis: Data Centers' *POLITICO* (3 October 2022) <https://www.politico.eu/article/data-center-energy-water-intensive-tech/>.

[89] See Roach and Krukowska (n 97); Government of Ireland, Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy (2022).

[90] See Roach and Krukowska (n 97);

[91] See Tom Burt, 'The Hybrid War in Ukraine' (*Microsoft On the Issues*, 27 April 2022) <https://blogs.microsoft.com/on-the-issues/2022/04/27/hybrid-war-ukraine-russia-cyberattacks/>; Digital Security Unit, 'Special Report: Ukraine - An Overview of Russia's Cyberattack Activity in Ukraine' (Microsoft 2022). John Naughton, 'How Russia and Ukraine Are Finding New Ways to Use Tech in the War' *The Observer* (7 May 2022) <https://www.theguardian.com/commentisfree/2022/may/07/how-russia-and-ukraine-are-finding-new-ways-to-use-tech-in-the-war>.

such as China or the US, which do not share the same standards in terms of fundamental rights protection.[92]

4.2 Antithetical effects on EU climate change mitigation strategies

This section focuses on the current energy crisis's potential impacts on the EU green transition. It starts by discussing the potential benefits of the energy crisis for mitigating GHG emissions and then considers its potential drawbacks. Overall, the analysis indicates that the energy crisis has an ambiguous effect on the EU's green transition — whether it will help or hinder the green transition will depend on various contingent factors.

The energy crisis can help to reduce GHG emissions from the EU in two main ways: first, by acting as a non-regulatory form of implicit carbon price on fossil fuels; secondly, by increasing political support for investments in non-fossil sources of energy. The significant increase in the price of fossil fuels experienced in 2022 has sets incentives to decarbonize that partially resemble those of a carbon pricing instrument.[93] Similar to a carbon price, an increase in fossil fuel prices incentivizes households, businesses, and the public sector to reduce the consumption of these fuels and of goods and services produced and distributed through the consumption of these fuels. This reduced consumption can result from behavioural adjustments (e.g., driving less or using less heating) or investments in energy efficiency technologies (e.g., heat pumps or improved insulation of buildings). High energy prices can also mitigate risks of rebound effects from the adoption of energy efficiency technologies — meaning that with high energy prices energy efficiency improvements are less likely to lead to greater consumption of fossil fuels.[94] Furthermore, similarly to a carbon price, an increase in fossil fuel prices can stimulate investments in innovation for green technologies. For instance, evidence indicates that energy prices have been found to have a strong positive effect on US patents for energy-efficiency technologies.[95] Lastly, and perhaps most importantly, high fossil fuel prices can make alternative energy sources more competitive, potentially unlocking investments needed to decarbonize the EU economy — such as in solar, wind, and hydropower infrastructure.

It is important to stress that some of the theoretical climate benefits discussed above may not materialise in practice. A key reason for this is that energy prices have fluctuated significantly over the past year, and uncertain price signals can discourage long-term investments in the

[92] See Luciano Floridi, 'The Fight for Digital Sovereignty: What It Is, and Why It Matters, Especially for the EU' (2020) 33 Philosophy & Technology 369; Celeste (n 18).

[93] Brent Crude Oil. <https://www.marketwatch.com/investing/future/brn00?countrycode=uk>; WTI Crude <https://www.cnbc.com/quotes/@CL.1>; Dutch TTF GAS <https://www.barchart.com/futures/quotes/TG*1>; Global Price of LNG <https://fred.stlouisfed.org/series/PNGASJPUSDM>.

[94] For a discussion of rebound effects from the adoption of energy efficiency technologies and the role of higher energy costs in addressing these risks, see Baranzini, A., Van den Bergh, J. C., Carattini, S., Howarth, R. B., Padilla, E., & Roca, J. (2017). Carbon pricing in climate policy: seven reasons, complementary instruments, and political economy considerations. Wiley Interdisciplinary Reviews: Climate Change, 8(4), 462.

[95] Popp, D. (2002). Induced innovation and energy prices. American economic review, 92(1), 160.

production and deployment of low- and zero-carbon technologies and infrastructure.[96] Besides mimicking the effects of an implicit carbon price, the energy crisis has brought energy security to the forefront of the agenda of many EU countries and institutions, meaning that there is now greater attention to the importance of reducing the EU's reliance on third countries for the provision of energy. Since many EU countries have limited fossil fuels available in their territory, reducing dependence on third countries implies — at least in the medium-long term — a shift to alternative energy sources. The EU has adopted a new set of measures to diversify energy supply, reduce energy consumption and increasing renewable energy investments – the so called RePowerEU plan.[97] In the meantime, various EU countries have taken steps in the same direction.[98] Politically, the 'energy security' rationale for decarbonizing the EU economy may help to catalyse broad public support for GHG policies because strengthening energy security may be seen as a less partisan argument than addressing climate change and may resonate well also with political parties that traditionally have been less supportive of climate change policies.

While the energy crisis can help the EU decarbonize, there are potential ways it can also hinder GHG emissions reductions. In particular, we distinguish three broad ways in which the energy crisis can have a negative effect on the EU decarbonization agenda: inflation, reduced ambition in climate change policies, and increased consumption of coal.

High inflation has become a key concern for EU governments and institutions after decades of slow-rising average prices within the EU area. The energy crisis is one of the key determinants of inflation. High inflation can negatively impact climate change mitigation in at least three ways. First, in response to rising inflation, the ECB, like many other central banks, has recently increased interest rates. A higher cost of capital is a drag on investments in green technologies and infrastructure.[99] Second, inflation erodes the real value of environmental and energy charges,[100] thereby mitigating the GHG benefits of these instruments. This issue does not concern only carbon taxes per se, but more broadly charges that discourage the consumption of fossil fuels, such as pay-as-you-drive road tolls that apply exclusively to fossil-fuelled

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[96] Dominioni, G., & Faure, M. (2022). Environmental Policy in Good and Bad Times: The Countercyclical Effects of Carbon Taxes and Cap-and-Trade. Journal of Environmental Law, 34(2), 269-286; Stavins, R. N. (2022). The Relative Merits of Carbon Pricing Instruments: Taxes versus Trading. Review of Environmental Economics and Policy, 16(1), 62.

[97] Council of the EU, EU recovery plan: Council adopts REPowerEU, Press release, 21 February 2023, <https://www.consilium.europa.eu/en/press/press-releases/2023/02/21/eu-recovery-plan-council-adopts-repowereu/?utm_source=dsms-auto&utm_medium=email&utm_campaign=EU%20recovery%20plan%3A%20Council%20adopts%20REPowerEU#:~:text=The%20Council%20today%20formally%20adopted,on%20Russian%20fossil%20fuel%20imports>; Euronews, Germany completes LNG terminal in move to diversify energy supply, 6/11/2022, <https://www.euronews.com/2022/11/16/germany-completes-lng-terminal-in-move-to-diversify-energy-supply>

[98] See, for instance, Country Report - Italy Accompanying the document Recommendation for a Council Recommendation on the 2023 National Reform Programme of Italy and delivering a Council opinion on the 2023 Stability Programme of Italy {COM(2023) 612 final}.

[99] Calthrop, E., (2022), Energy crisis makes public banks even more important, European Investment Bank, 2022, <https://www.eib.org/en/stories/energy-crisis-net-zero-transition>.

[100] Dominioni, G., & Heine, D. (2019). Behavioural economics and public support for carbon pricing: A revenue recycling scheme to address the political economy of carbon taxation. *European Journal of Risk Regulation*, 10(3), 554-570.

vehicles and excise taxes on gasoline and diesel that do not target the carbon content or GHG emitted by burning these fuels. Since many countries do not have systems in place to automatically update the level of these charges to inflation,[101] high-inflationary periods can reduce incentives to decarbonize.

High inflation — and energy security issues — can reduce support for more stringent GHG policies if these are perceived as a cause of these problems. Experience indicates that governments often struggle to implement ambitious GHG mitigation policies if the public opposes these.[102] Some British commentators have been reported supporting a causal link between net-zero pledges, energy insecurity, and inflation.[103] If such ideas gain traction in society, energy security concerns may reduce investments in low- and zero-carbon technologies and infrastructure instead of increasing them. More broadly, the energy crisis may hinder ambition in climate change policy if governments fear strong negative public reactions to policies that increase the cost of consuming fossil fuels in a time of highly fluctuating energy prices. Experience, such as the 2018 Gilets Jaunes protests in France, indicates that rising energy prices can trigger a significant political backlash against climate policy that increases the marginal cost of consuming fossil fuels.[104]

Lastly, a negative effect of the energy crisis on the EU decarbonization agenda that has already materialised in various jurisdictions concerns a temporary increase in coal consumption to compensate for the reduced imports of Russian fossil fuels. For instance, Germany has increased its reliance on coal for power generation by reopening and extending the life of several coal-fired power plants.[105] Austria has adopted a similar measure.[106] Italy has included in its plan to address the energy crisis the possibility of using existing coal plants at full capacity during Winter 2022-2023.[107] While this increased reliance on coal is meant to be temporary, it will still have a negative effect on the climate as coal combustion produces greater GHG emissions than other fossil fuels.

Before concluding, it is important to stress that the energy crisis is a threat to the achievement of one of the aims of the EU green agenda that does not concern GHG reductions per se, but that is an important component of the EU Green Deal: the social objective of 'not leaving

[101] OECD, 'Taxing Energy Use 2018: Companion to the Taxing Energy Use Database' (OECD Publishing, Paris 2018).

[102] Dominioni and Esty (n 30).

[103] Clark, P., Don't underestimate the power of climate bullshit (Financial Times, 2022) <https://www.ft.com/content/c6b71297-f3c9-4549-8c6f-d1c828c6344f>.

[104] O'Sullivan, F., 2018, Why Drivers Are Leading a Protest Movement Across France, Bloomberg, <https://www.bloomberg.com/news/articles/2018-11-19/-yellow-vests-why-france-is-protesting-new-gas-taxes>.

[105] Dezem, (n9)

[106] Lory, G., 2022, Austria to reopen closed coal-fired power station, despite climate goals, Euronews, <https://www.euronews.com/my-europe/2022/06/28/austria-to-reopen-closed-coal-fired-power-station-despite-climate-goals>.

[107] IlSole24Ore, 2022, Riapertura Centrali a Carbone: Ecco i Siti che Torneranno a Pieno Regime, <https://www.ilsole24ore.com/art/da-brindisi-monfalcone-ecco-centrali-carbone-che-saranno-riaccese-massimo-AEz8xAyB>.

anyone behind'.[108] The energy crisis has heightened equity concerns as higher energy prices often affect less affluent segments of society. A recent study indicates that EU governments have earmarked/allocated 600.4 billion euros to shield consumers from higher energy prices.[109] In addition, the EU has adopted a European Social Climate Fund to support vulnerable groups during the energy transition.[110] Yet, these interventions do not fully offset the negative impacts of energy costs on consumers and sometimes are not adequately targeted to less affluent segments, spend a greater share of their income on energy consumption, and are more exposed to energy poverty risks.

5. Conclusion: Towards an EU integrated approach to the twin transitions

The analysis above indicates the existence of significant synergies between the digital and the green agendas. If exploited, such synergies may help strengthening the EU response to key challenges it faces in the short term — such as addressing increasing energy security — and longer-term ones — such as addressing climate change. However, existing research indicates that — with some important exceptions — the green and digital agenda are rather developing in silos.[111]

The development of digital technology in the EU and the achievement of digitalised and just society cannot prescind from environmental considerations. Digital technology products must be produced in a sustainable way and the importance of digital infrastructures should be taken into account when assessing ways of improving the efficiency and reliability of the energy grid. The green transition must be linked with the digital one to be implemented in a fast and scalable way.[112] The twin transitions have to be regarded in an integrated way and not as two concurrent processes.[113]

[108] European Commission, A European Green Deal, 2022, <https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en>.

[109] Sgaravatti G., Tagliapietra S., Zachmann G., 2022, National fiscal policy responses to the energy crisis, Briegel, <https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices>.

[110] Council of the European Union, 2023, Fit for 55: a fund to support the most affected citizens and businesses <https://www.consilium.europa.eu/en/infographics/fit-for-55-social-climate-fund/>

[111] Santarius, T. et al. (2023) 'Digitalization and Sustainability: A Call for a Digital Green Deal', Environmental Science & Policy, 147; Gailhofer, P. et al., The role of Artificial Intelligence in the European Green Deal, Study for the special committee on Artificial Intelligence in a Digital Age (AIDA), Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg, 2021.

[112] Thomas Leurent, '"Europe Must Embrace 'Green Digital' to Disrupt and Drive the Energy Transition"' (*Recharge | Global news and intelligence for the Energy Transition*, 27 May 2022) <https://www.rechargenews.com/energy-transition/europe-must-embrace-green-digital-to-disrupt-and-drive-the-energy-transition/2-1-1226522>.

[113] See Joint Research Centre (European Commission) and others (n 43); Johanna Lehne and Sara Dethier, 'Recasting the "Twin" Green and Digital Transitions as One Integrated Challenge' (*E3G*, 18 June 2020) <https://www.e3g.org/news/recasting-the-twin-green-and-digital-transitions-as-one-integrated-challeng/>; Luciano Floridi, *Il verde e il blu: idee ingenue per migliorare la politica* (Raffaello Cortina editore 2020).

Clusters that are able to respond to multiple policy issues may be a solution.[114] The current war and energy crisis could be the shock needed to boost support for long waited policy objectives, including renewable energies and a human centric and fundamental rights compliant digital technology.[115] The ultimate aim would be integrating the two transitions further, with the individual in mind, to make this twofold transition more equitable, as underlined in the objectives of the EU Commission.[116]

[114] Arnault Morisson and Marc Pattinson, *Clusters: Driving the Green and Digital Twin Transition* (Interreg Europe Policy Learning Platform 2021).

[115] Lauren Chadwick, 'Europe's Energy Crisis: How Will EU Ministers Address Rising Prices?' (*Euronews.*, 9 September 2022) <https://www.euronews.com/my-europe/2022/09/09/europes-energy-crisis-how-will-eu-ministers-address-rising-prices>.

[116] European Commission, Commission Work Programme 2020 - A Union that strives for more 2020 [COM(2020) 37 final].