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Digital and green: twice the transformation, twice the win?

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Ladies and gentlemen, good afternoon.

The conference on 'The macroeconomic and financial dimensions of the green transition' is now coming to a close. Let me warmly thank all the participants who have contributed to the success of this initiative, co-organized by Banca d'Italia, the European University Institute, the Euro Area Business Cycle Network and the Centre for Economic Policy Research.

The value of this event lies not only in the attempt to shed light on key economic and financial issues linked to the energy transition and the ongoing decarbonization process, but also in gathering together academics and researchers from central banks, other policy institutions and universities in an attempt to foster critical thinking and new collaborations. Needless to say, the analyses of such an outstanding pool of experts are essential in supporting decision-makers in the public and private sectors who have to cope with the multiple challenges of the transition.

Yet while the programme has focused on many of the climate-related challenges, in my brief concluding remarks today, I would like to highlight another challenge that I think warrants further investigation: the twin transition, which lies at the intersection of the green and the digital transformations.[1]

The digital and green twin transitions

We are living in a world where the digital transition and the green transition are mostly taking place on parallel tracks, although some commentators have underlined

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[1] With thanks to Ivan Faiella, Luciano Lavecchia and Juri Marcucci for their valuable contributions.

some possible interactions.[2] When people think about these transitions, they tend to highlight the negative impact of the digital transition on the climate, and specifically that the expansion in power-hungry digital technologies and services will increase their environmental footprint.

Indeed, according to the International Energy Agency (IEA), data centres, cryptocurrencies and Artificial Intelligence (AI) in 2022 accounted for about 2 per cent of global electricity use. The US Energy Information Administration calculates that in 2022, cryptocurrencies alone may have drained more than 2 per cent of the national annual power use.[3] A recent study[4] shows that, on average, generating an image through AI consumes as much electricity as fully charging a smartphone, and this is on top of the energy used to train the algorithms. This should serve as a warning, as the number of people worldwide using these tools, even for entertainment, is increasing at an incredible rate. There is the dreadful prospect that, in a high-demand scenario, digitalization-related energy needs could even double in 2026.[5]

Clearly, these developments call for further progress in increasing the share of low-carbon sources in the power mix,[6] and for measures to improve the energy efficiency of these digital services.[7]

Luckily, on the other side, there are also many good things that the digital transition can do for the green transformation. AI tools – such as machine learning and deep learning – can, for example, assist economists, investors, and portfolio managers in improving the use of ESG data to build efficient portfolios[8] as well as help scientists in assessing the extent of biodiversity loss,[9] map methane leaks[10] or water availability.[11]

In what follows, I would like to mention some practical uses of digital innovation for the green transformation that should be taken into consideration and studied further,

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2 On the reinforcing of the green and digital transitions, see Muench, S. et al., 2022. 'Towards a green and digital future'.

3 EIA (2024). Tracking electricity consumption from U.S. cryptocurrency mining operations.

4 Luccioni, S., Jernite, Y., and Strubell, E. (2023). Power Hungry Processing: Watts Driving the Cost of AI Deployment? Proceedings of the 2024 ACM Conference on Fairness, Accountability, and Transparency.

5 IEA 2024. Electricity 2024. Analysis and forecast to 2026.

6 According to the above mentioned IEA Electricity report, low-carbon electricity generation is set to cover all global demand growth over the period 2024-26.

7 Zhu, H. et al., 2023. Future data center energy-conservation and emission-reduction technologies in the context of smart and low-carbon city construction, Sustainable Cities and Society, Volume 89, February 2023, 104322.

8 Lanza, A.A.G. et al., 2023. Machine Learning, ESG Indicators, and Sustainable Investment, Financial Risk Management and Climate Change Risk, Springer Nature Switzerland.

9 Thompson, T., 2023. How AI can help to save endangered species, Nature, 623, 232-233.

10 O'Donnel, J., 2024. A new satellite will use Google's AI to map methane leaks from space, MIT Technology review, February 14, 2024.

11 Shaikh, M. and F., Birajdar, 2024. Artificial intelligence in groundwater management: Innovations, challenges, and future prospects, International Journal of Science and Research Archive, 2024, 11(01), 502-512.

potentially also among economists like you. Although at the moment these potential positive uses are still overshadowed by the large amount of energy required by digital technologies, this does not mean that researchers should not push the frontier in these areas. I will start by discussing AI-generated energy demand and supply as well as weather forecasts[12] and how they can support climate mitigation and adaptation. I will then turn to the use of digital solutions to reinforce the green transition.

AI can help with climate transition and adaptation

AI solutions can foster the reliability of energy systems, deliver higher living standards, and ensure safety for populations and production. The power of AI possibilities is something we experience directly: nowadays smartphones and digital assistants provide a number of cheap and simple home automation solutions; by coupling the Internet of Things (IoT) with AI techniques, we can monitor and optimize the heating and cooling of our homes. Outside of these day-to-day examples, however, there are many more ways that AI can be seen as a 'climate game changer'. Our smart-home solutions are just the tip of the iceberg.

Gaining a greater understanding of both when power is available and when it is needed is crucial to ensure the efficiency and reliability of the power grid, especially once an increasing share of intermittent renewable sources are integrated. The deployment of smart meters to collect information, and of digital technologies such as machine learning techniques for data analyses can lead to better forecasts of energy demand and supply, leading to improvements in energy efficiency. In addition, by supporting 'demand response', technology could minimize discrepancies between demand and supply, reducing 'peak loads' and the need to add capacity to manage those peaks, and in turn supporting the resilience and security of the energy infrastructure.

In addition to enhancing energy demand and supply forecast and management, AI technologies can help improve weather forecasts as well as the early warning detection of acute climate events, which are essential tools for mitigating the impact of adverse events on populations and assets. Progress in forecasting weather patterns and building climate scenarios could help vulnerable communities and authorities to adapt to climate change[13] and could transform climate adaptation strategies in agriculture[14] (e.g. through optimized water use, early warning systems on invasions of alien species and selection of resistant crop varieties in response to climate change scenarios) and in the insurance sector[15] (e.g. providing vast amounts of data to improve climate risk assessment and the pricing policies for climate-related damage protection).

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12 Bi, K. et al., 2023. Accurate medium-range global weather forecasting with 3D neural networks, Nature, 619, 533-538. Lam, R. et al., 2023. Learning skillful medium-range global weather forecasting, Science, 382, 6677, 1416-1421.

13 Kyungmee, K. and Boulanin, V., 2023. Artificial Intelligence for Climate Security. Possibilities and Challenges, Stockholm International Peace Research Institute.

14 De Baerdemaeker, J. et al., 2023. Artificial intelligence in the agri-food sector, Scientific Foresight Unit, European Parliamentary Research Service.

15 McLaughlin, M., 2022. Climate change is a major challenge for insurers, but AI and cloud can help, IBM IBV Blog.

Digital solutions can help with climate disclosure and climate-risk identification

Other areas in which digital innovation can help with climate transition are the assessment and selection of tools to channel funds towards green and sustainable finance, the progress in sustainability disclosure, the collection of climate-related information, and the evaluation and monitoring of climate-related financial risks, just to name a few important themes. Let me briefly describe some of the efforts in these areas.

First, the BIS Innovation Hub and Banca d'Italia launched the G20 TechSprint Initiative in 2021, a global technological competition in the form of a long hackathon designed to show the potential for new technologies, new (big) data, and other innovations to leverage on the potential synergies between digitalization, finance and the energy transition.[16] Another initiative in which Banca d'Italia was involved is the 2021 first call for proposals by the Milano Hub, the Banca d'Italia innovation centre located in Milan. Some of the projects developed under this umbrella showed how technology, and particularly AI, can contribute to improving financial services, in terms of ESG data collection and production.[17]

Second, supply chain partners, financial regulators and financial entities increasingly require that companies, including small and medium enterprises (SMEs), provide some kind of sustainability reporting. Digital platforms could reduce the disclosure burden. Within this context, the United Nations Development Programme (UNDP), the Monetary Authority of Singapore (MAS), and the Global Legal Entity Identifier Foundation (GLEIF) proposed a framework to address SMEs' sustainability disclosure, harnessing technology and verified data to improve sustainability reporting while lowering costs and barriers to reporting.[18]

Third, AI – particularly large language models (LLMs) – can help analysts and supervisors in collecting climate-related information from corporates. The BIS Innovation Hub, Banco de España, Deutsche Bundesbank, and European Central Bank launched a project that leverages LLMs to automatically extract climate-related indicators from publicly available corporate reports, thus enabling a widespread and cost-effective analysis of climate-related financial risks.[19]

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16 Ignazio Visco, G20 TechSprint 2021 – Presentation Event, The G20 TechSprint 2021 on Sustainable Finance, May 2021.

17 One study proposed a method to address the ESG data collection problem by using adaptive AI and natural language processing techniques, showing their effectiveness with real-world documents (Visalli F. et al., 2023. ESG Data Collection with Adaptive AI. In Proceedings of the 25th International Conference on Enterprise Information Systems – Volume 1: ICEIS, ISBN 978-989-758-648-4, SciTePress, pages 468-475. DOI: 10.5220/0011844500003467). Another study used machine learning tools to predict the energy performance certificates (EPCs) of the overall stock of Italian buildings, revealing a discrepancy with the distribution inferred from the national cadaster (SIAPE), thereby having significant implications for policy formulation (Braggiotti F. et al., 2024. Predicting buildings' EPC in Italy: a machine learning based-approach, Banca d'Italia, Questioni di Economia e Finanza, n. 850).

18 United Nations Development Programme, 2024. White Paper on Project Savannah: Common ESG Metrics for Generating Digital Sustainability Credentials for MSMEs, issued jointly by UNDP, MAS and GLEIF.

19 BIS, 2024. Project Gaia. Enabling climate risk analysis using generative AI.

Finally, digital platforms can support sustainable finance by integrating a vast array of regulatory and supervisory data together with market analytics in order to support central banks and financial supervisors to improve their monitoring of climate-related financial risks. In 2022, the BIS Innovation Hub and the Monetary Authority of Singapore launched a climate risk platform exactly for this purpose.[20]

Conclusions

The green and the digital transitions are happening whether we like it or not. We need research to try and understand how they can reinforce each other.

One possible area of work is trying to further improve our understanding of which AI tools and other digital developments can be used to support the green transition and improve climate science.[21] For example, AI techniques could be exploited to improve the preparation of climate scenarios, replicating the results of conventional models, but taking less computational time and consuming less energy.[22] AI solutions could also be used by governments to leverage massive sources of freely available climate-related data (e.g. risk maps, satellite imagery and so on) and to generate tailored insights.[23]

In addition, some efforts should focus on assessing how some disruptive technologies (such as additive manufacturing in industry, mobility-as-a-service in transportation and AI in buildings) can help to decarbonize hard-to-abate sectors.[24] In imagining future decarbonization pathways, researchers should take into account the disruptive impact of digital technologies on energy demand, economic growth and social development.[25]

Last but not least, another potential area of research is the crucial issue of how to design incentives that could help the two transitions co-evolve and reinforce each other. Historical evidence suggests that twin transitions tend to be lopsided: while we will

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20 BIS, 2024. Project Viridis. A climate risk platform for financial authorities.

21 Rylander, Y., 2024. How will artificial intelligence influence climate science?, Stockholm Environment Institute.

22 The conventional physics-based models take weeks to run and are energy-consuming: simulating a century requires the amount of electricity used annually by the average US household. See Wong, C., 2024. How AI is improving climate forecasts, Nature, 628, 710-712.

23 Peixoto, T. C. et al., 2023. Leveraging data and Artificial Intelligence for climate-smart decision-making in government, World Bank Blogs.

24 For example, the Disruptive Digitalization 4 Decarbonization (2D4D) project, funded by the European Research Council under the European Union's Horizon 2020 research and innovation programme, aims to carry out a comprehensive assessment of the macro-economic implications of the concurrent digitalization and decarbonization pathways.

25 Creutzig, F. et al., 2022. Digitalization and the Anthropocene, Annual Review of Environment and Resources, Volume 47, 479-509.

probably experience unceasingly fast progress in the digital world,[26] the transition away from fossil fuels will require extended periods of development.[27]

In this context, how can we maximize the synergies between the two transitions in order to gradually wean future economic growth away from fossil-based energy? We have to consider that green policies also encourage firms' digitalization; for example, environmental regulation as well as market-based measures (e.g. carbon pricing) promote resource efficiency, and digital solutions are essential in achieving this objective.[28]

These are just a few examples, of course. What I would like you to take away is that it is really important that the community of academics, central bankers and practitioners put some of these topics on their research agenda so that we can do our best to maximize the benefits in our quest for achieving twice the win in the twin transition.

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26 Fouquet, R., and Hippe, R., 2022. Twin transitions of decarbonisation and digitalisation: A historical perspective on energy and information in European economies, Energy Research & Social Science, Volume 91, 102736.

27 "*We should not ignore the experience of the past grand energy transition (from traditional biomass energies to fossil fuels) and we should not underestimate the concatenation of challenges presented by practical engineering, material, organizational, social, political, and environmental requirements of the unfolding transition to a fossil carbon-free world*". Smil, V., 2024. Halfway Between Kyoto and 2050. Zero Carbon Is a Highly Unlikely Outcome, Fraser Institute.

28 Fan, J. et al., 2024. Informal environmental regulation and enterprises digital transformation: A study based on the perspective of public environmental concerns, Ecological Indicators, Volume 163.