POLICY BRIEF

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Engineering Digital Public Infrastructure for a Sustainable Future: Rationale and Policy Pathways

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Digital Transformation

Abstract

The concept of Digital Public Infrastructure (DPI) has gained significant attention since the G20 India Presidency, with subsequent presidencies Brazil and South Africa advocating global frameworks to govern the use of digital technologies that support public infrastructures, open-source software, and private data flows. However, many of these initiatives disregard the implications of digitalisation for sustainability. In light of the multiple challenges faced by the world, including climate change, decarbonisation, and dematerialisation, numerous global environmental agreements have been established. Regrettably, these two realms of policymaking are often disconnected, failing to systematically address how digital transformation can contribute to sustainable economic growth. Recently United Nations Development Program (UNDP) and International Telecommunication Union (ITU) high impact Initiative on DPI outlined key action areas that unify global initiatives towards some of the Sustainable Development Goals (SDGs).

This policy brief aims to address this gap by outlining key pathways that can guide G20 policymakers in utilising digital public infrastructure to achieve the Sustainable Development Goals (SDGs). It provides a systemic perspective on greening the procurement and supply chains, enhancing smart city applications, scaling up corporate environmental practices within big tech companies, and establishing a global governance architecture for DPI. By fostering these pathways, policymakers can advance a more interconnected north-south cooperative approach to sustainable digital transformation.

Keywords: digital transformation, decarbonization, e-governance, smart cities, Sustainable Development Goals

Diagnosis of the issue

Digital Public Infrastructure (DPI) is a transformative process in social infrastructure provision that utilises ubiquitous digital technologies to connect economic spaces and actors. By collecting, analysing, and intelligently utilising data for real-time problem-solving, DPI and its progressive applications can play a pivotal role in achieving faster and more inclusive economic growth[1]. Moreover, DPI serves as a crucial driver for sustainability transformation, aligning with international environmental agreements like the Paris Climate Accord, the United Nations 2030 Sustainable Development Agenda, and the Montreal Protocol.[2]

The leaders of the G20 have acknowledged the importance of the digital economy and have taken action to harness its benefits. These efforts include initiatives such as the G20 Digital Economy Working Group (DEWG), which aims to facilitate collaboration amongst G20 members in promoting meaningful digital connectivity, building digital skills, and enhancing DPI. The Declaration of the G20 New Delhi Summit emphasised the need for policy cooperation to fully unleash the potential of DPI, with a particular focus on data governance to enable cross-border data flows. Building upon the efforts of previous presidencies, Global South G20 presidencies of Indonesia (2022), Indian (2023), Brazil (2024) and South Africa (2025) have identified key themes related to DPI that include sharing experiences on the implementation of digital identity in different countries, exchanging cybersecurity solutions for small businesses along supply chains, leveraging geospatial technologies for infrastructure development, and utilising digital public infrastructure to advance the achievement of SDGs.

[1] India's G20 Presidency https://www.g20.in/en/

[2] UNDP (2023). Accelerating The SDGs Through Digital Public Infrastructure: A Compendium of The Potential of Digital Public Infrastructure https://www.undp.org/publications/accelerating-sdgs-through-digital-public-infrastructure-compendium-potential-digital-public-infrastructure

While digital transformation, social equity, and sustainable development are prioritised by G20 countries there remains a disconnect between this discourse and DPI value creation, assumptions, and sustainability impacts in developing countries, particularly those in Africa. There is a need for increased efforts, leverage, and utilisation of DPI to effectively deliver on the Sustainable Development Goals (SDGs).[2]

Emerging scholarship and policy discussions on DPI have primarily focused on the digitalisation of public services and efficiency gains enabled by technologies. Articulating a clear reference to identify how the G20 frames the sustainability value to be created by DPI is a pressing need.

A comprehensive review of the interconnections between digitalisation and the SDGs is available and summarised in Appendix A- 1. However, it is crucial to recognise that digital technologies are continually evolving and can result in unintended consequences, such as increased energy consumption from unsustainable use of digital devices, which can undermine climate mitigation efforts. Therefore, it is essential to measure the impacts of DPI on a Sustainable future, which is interlinked as shown in Appendix A-2.

Currently, there is uncertainty regarding blind policy spots and how to maximise the opportunities provided by DPI to achieve the SDGs[3].[5] Identifying these opportunities and challenges requires proactive actions by the G20.

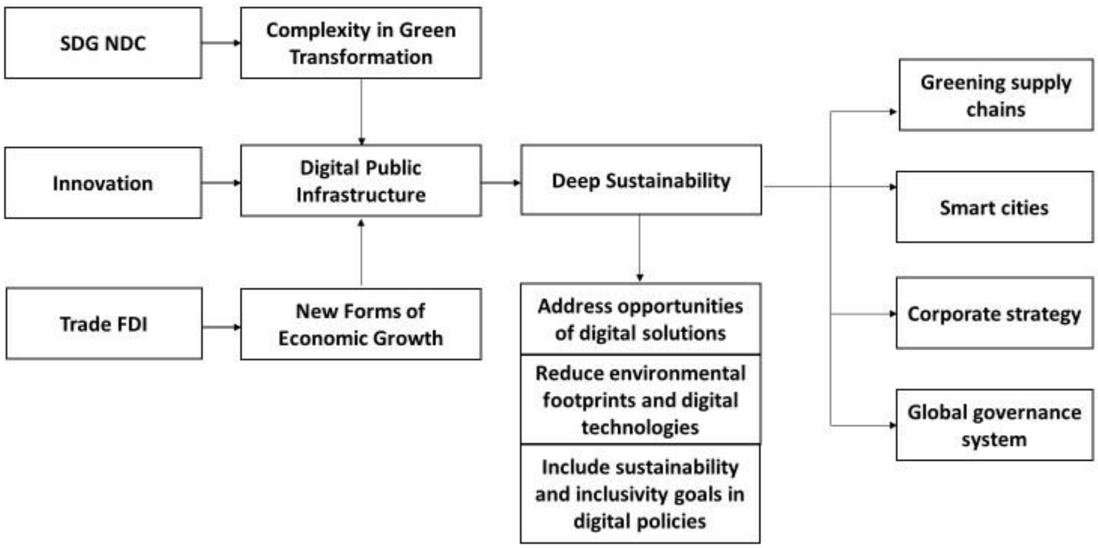
Recommendations

Sustainability potentials of DPI can be realised through a strategic examination of opportunities and risks. Figure 1 illustrates the three policy pathways through which

[3] George Ingram, John W. McArthur, and Priya Vora, "How Can Digital Public Technologies Accelerate Progress on the Sustainable Development Goals?", Brookings, last modified May 25, 2022, https://www.brookings.edu/research/how-can-digital-public-technologies-accelerate-progress-on-the-sustainable-development-goals/

DPI can contribute to achieving a sustainable future, along with the drivers and benefits associated with each path .

Figure 1: Pathways for DPI as a Platform Solution for Sustainability Challenges



Source: Authors

Based on emerging experiences, there are three key pathways through which DPI can serve as a platform for addressing the sustainability challenges of reducing the environmental footprint and inclusivity in development.

Recommendation 1: Set the Directionality and Orchestrate the Process of Greening the Global Supply Chains through DPI Platforms

Digital technologies have the potential to drive the transformation of global trade and supply chains towards decarbonisation, which is essential for meeting climate targets and building a sustainable economy. The rapid growth of global trade and supply chains has contributed to income growth and poverty reduction in developing countries, but has also led to increasing carbon emissions. Notably, Asian value chains of manufactured goods have experienced a significant rise in CO_2 emissions embodied in gross exports, increasing from 1,516 million tonnes in 1995 to over 4,505 million tonnes in 2019[4]

Recent research has demonstrated the positive impact of digitalisation on environmental sustainability, particularly in countries like China, Germany, and Brazil[5]. Industry 4.0 technologies have shown moderate to significant improvements in resource efficiency along supply chains (Appendix A-3). Despite the enormous potential of digitalisation and the DPI provision, global trade processes remain predominantly paper-based. Implementing electronic documents and e-transactions as a part of the extension of DPI services can enhance trade logistics efficiency, significantly reduce trade costs, and bring environmental benefits. Paperless trade, when coupled with green logistics, has the potential to eliminate between 9 and 23 million tonnes of CO_2 emissions annually at the global level[6].

Implementing the WTO Trade Facilitation Agreement (TFA) is identified as a priority action by G20. The TFA can streamline border procedures, enhance transparency, and improve the movement, release, and clearance of goods. Integrated transport management systems and digital logistics platforms can contribute to improved trade flows and reduced congestion at borders. However, the implementation of the TFA, particularly in areas like paperless trade and support for small and medium-sized enterprises (SMEs), remains incomplete. G20 should set direction and develop a set of tools that integrate certain layers of DPI with norms and affordances designed around greening the supply chains. In the broader sense, G20 supply chain-related industrial and trade policies that

[4] UN Global Survey on Digital and Sustainable Trade Facilitation, available at https://untfsurvey.org/

[5] Grischa Beier et al., "Implications of Industry 4.0 on Industrial Employment: A Comparative Survey from Brazilian, Chinese and German Practitioners," *Technology in Society* 70, (2022), https://doi.org/10.1016/j.techsoc.2022.102028

[6] . Yann Duval, Celine Bacrot, and Simon Hardy, "Quantifying the Environmental Benefits from Paperless Trade Facilitation," United Nations Conference on Trade and Development (UNCTAD), last modified November 2, 2021, https://unctad.org/news/quantifying-environmental-benefits-paperless-trade-facilitation

aim to combine DPI and decarbonization should be guided by the Sustainable Development Goals (SDGs).

Recommendation 2. Responsibly Integrate DPI Applications in Smart Cities for SDG Advancement

Cities accommodate approximately 55% of the global population and contribute to 85% of the global economic output by 2050[7]. However, they are also accountable for 70% of CO_2 emissions and over 60% of resource consumption. Most cities in G20 economies face significant challenges in meeting the triple objectives of economic productivity, social inclusivity, and environmental sustainability. In the context of SDGs, ensuring access to essential public services is a primary focus, followed by promoting sustainable use of energy, waste, and water services, as well as effective management of environmental issues and disasters.

While acknowledging that countries might have different approaches to DPI and may implement components in various ways, the G20 clearly identified three layers as fundamental to DPI. (Appendix A-4). DPI can be understood as an intermediate layer in the technology stack between physical, logical applications layers, including internet connectivity, devices, data centres, and sectoral applications such as remote education, social protection, disaster information, and telehealth.

DPI's applications, when twinned with infrastructure, could harness large volumes of data to enhance surveillance, liveability, equality, and capitalise on the advantages of urban density. For instance, transit-related analytics using data on ridership, traffic density, and road safety can increase the usage of public

[7] "Inclusive Cities: Development News, Research, and Data," The World Bank, accessed June 21, 2023, Inclusive Cities: Development news, research, data | World Bank

transit services, improve job accessibility, and contribute to carbon emissions reduction. Additionally, cities can deploy sensors to collect real-time data on air quality and electricity consumption in buildings. Appendix A-5 illustrates smart city initiatives in the Netherlands that are aimed at leveraging DPI infrastructure technology and data to enhance the quality of life in urban areas. In Salem, India, a cloud-based DPI infrastructure of connected devices and digital payments has successfully reduced energy usage in the city's LED-based lighting system, enhancing efficiency, cost-effectiveness, and safety for pedestrians and vehicles. Moreover, IoT devices connected to smart meters in Southeast Asian megacities have helped households save up to 15% on energy bills[8].

Digital twins, constructed using sensors and other DPI applications, create virtual replicas of cities, enabling monitoring of buildings, utilities, and vehicle movement. In Singapore, digital twins have contributed to a 25% reduction in municipal solid waste, facilitating improved resource allocation[9].

Recommendation 3: Advance Corporate Environmental Practices of Big Tech Companies for Deep Decarbonisation

To drive sustainable transformation, the integration of DPIs must prioritise two crucial objectives: decarbonisation and dematerialisation. Currently, a handful of big tech companies globally shape and design digital technologies and products. However, as shareholder-driven entities, their primary focus is on maximising profits, retaining users, and extracting data. To ensure digital technologies serve deep sustainability transformation, it is essential to align the intrinsic motivation and business models of these tech giants towards carbon

[8] Harald Bauer, Mark Patel, and Jan Veira, 'The Internet of Things: Sizing Up the Opportunity,' McKinsey & Company, last modified December 1, 2014, https://www.mckinsey.com/industries/semiconductors/our-insights/the-internet-of-things-sizing-up-the-opportunity#/

[9] Poterio, Amamia, 2019. Digital Twins and Urban Planning: How to use Replicas to Building the Cities of Tomorrow. Mag. https://tomorrow.city/a/digital-twins-made-with-minecraft-and-open-street-map

neutrality. Appendix A-6 shows the strategies by which companies can reduce their carbon footprints.

Big tech companies, leveraging their corporate environmental strategies, can also drive the transition to a net-zero economy through product and process innovations. For example, Intel, a US-based manufacturer of computer microprocessors, established an Ecotechnology group in 2010 dedicated to sustainable manufacturing and product use[10]. This interdisciplinary team continuously explores pathways to improve Intel's carbon footprint and offers carbon credits to customers.

However, it is important to address potential setbacks, such as increased carbon emissions in other areas. Data centres, owned by big tech companies, consume substantial amounts of energy for network operations and cooling. As of December 2024, there were over 6,300 data centres in G20 countries, experiencing the fastest growth in hyper-scale data centres[11]. These data centres account for approximately 1-3% of global electricity demand and 0.3% of global carbon emissions.[14] To combat this, Google has demonstrated that using AI tools can reduce data centre energy usage by 40%. Google has also undertaken efforts to decarbonise its data centres by consolidating them, eliminating 18 centres while establishing eight global hubs.

Another commitment made by big tech companies to the SDGs is the adoption of triple-bottom Corporate Social Responsibility (CSR) reporting. Tech enterprises like Toshiba, Amazon, and Wipro not only report their financial gains but also disclose their Environmental, Social, and Governance (ESG) performance through audited reports.

[10] Intel White Paper (2021). Green computing at scale. https://www.intel.com/content/dam/www/central-libraries/us/en/documents/intel-it-green-computing-at-scale-paper.pdf

[11] Erik Masanet et al., “Recalibrating Global Data Center Energy -Use Estimates.” *Science* 367, Issue 6481 (February 2020): 984-986, https://doi.org/10.1126/science.aba3758

To scale up these corporate environmental strategies and transform them into sectoral standards, G20 governments and standard-setting organisations should collaborate. They have the opportunity to harmonise these practices and establish guidelines for corporations to disclose their carbon efficiency using standardised reporting frameworks for annual investments. They can enhance the impact of corporate environmental practices and accelerate the transition towards a sustainable future through such collaborations.

These three targeted interventions by G20 will have a profound impact on shaping the next generation of DPIs and will essentially accelerate for achieving sustainable future by 2030.

Appendix A-1

Table A-1: Opportunities and Risks of Digitalisation

SDG	Opportunities of Digitalisation	Risks of Digitalisation
8 Decent work and economic growth	New forms of market access, employment opportunities.	Societal challenges posed by automation and new forms of work.
9 Industry, innovation, and infrastructure	Innovation promotion and transfer, e.g., to enable developing countries to leapfrog technological development stages or for smart city infrastructures.	Lack of the corresponding frameworks or other (e.g., development politics) problems that frequently hinder sustainable implementation.
10 Reduced inequalities	Reduce inequalities by enabling technological leaps, new forms of employment, and access to information, education, and health .	Promote inequalities through the reshoring of production, automation; or a widening digital divide.
12 Responsible consumption and production	Decoupling of economic development from resource and energy consumption, as well as a digitally enhanced change towards 'using instead of owning'.	Increased demand for resources and energy, short product cycles, and increasing quantities of electronic waste.

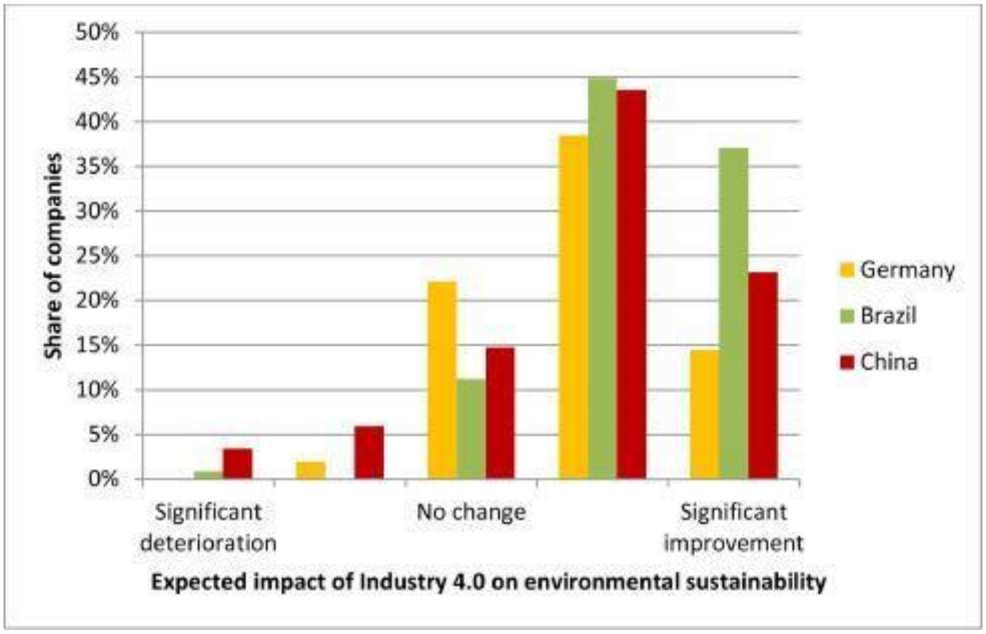
Appendix A 2 Differing status of DPI adoption and Progress in Sustainability Efforts in G20 countries

G20 Country	Digital Adoption Index[27]	SDG Index [28]	Climate Risk Index[29]	Environmental Performance Index (EPI)[30]	Gini Coefficient [31]
Argentina	0.68	72.8	60.0	41.1	42.3
Australia	0.71	75.6	28.0	60.1	34.3
Brazil	0.68	71.3	33.7	43.6	48.9
Canada	0.69	79.2	65.7	50.0	33.3
China	0.58	72.1	42.4	28.4	38.2
France	0.75	81.7	52.5	62.5	32.4
Germany	0.83	82.5	61.3	62.4	31.7
India	0.510	60.1	16.7	18.9	35.7
Indonesia	0.457	66.3	24.3	28.2	37.9
Italy	0.76	78.8	43.5	57.7	35.2
Japan	0.83	79.8	14.5	57.2	32.9
Korea, Rep.	0.85	78.6	64.0	46.9	31.4
Mexico	0.60	69.1	59.5	45.5	45.4
Russian Federation	0.74	73.8	50.7	37.5	36.0
Saudi Arabia	0.66	66.3	73.0	37.9	45.9
South Africa	0.63	63.7	32.5	37.2	63.0
Turkey	0.63	70.4	66.0	26.3	41.9
United Kingdom	0.76	80.0	90.8	77.7	35.1
United States	0.75	76.0	-	51.1	41.5
European Union[12]	0.75	79.5	79.2	61.4	30.9

[12] Data derived from averaging the total value of sub-index/ variable, for all European Union member countries.

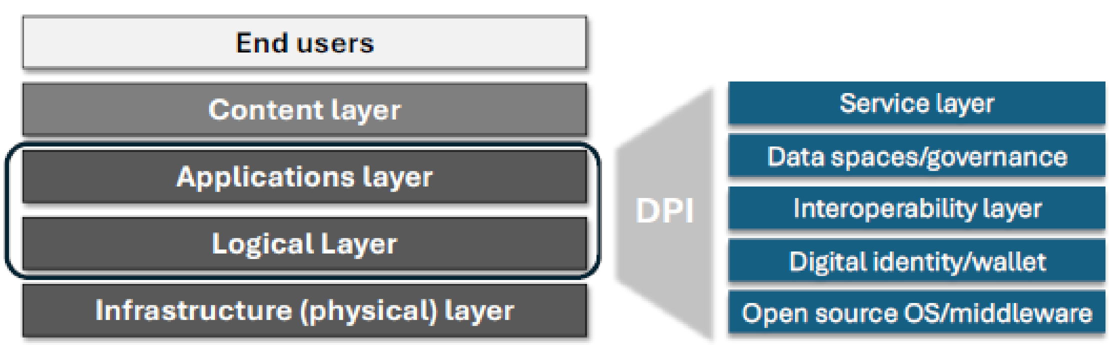
Appendix A-3

Implications of Digitalization on Environmental Performance



Source: Beier et al. (2022)

Appendix A-4 The interactive layers and Digital Public Infrastructure (DPI)

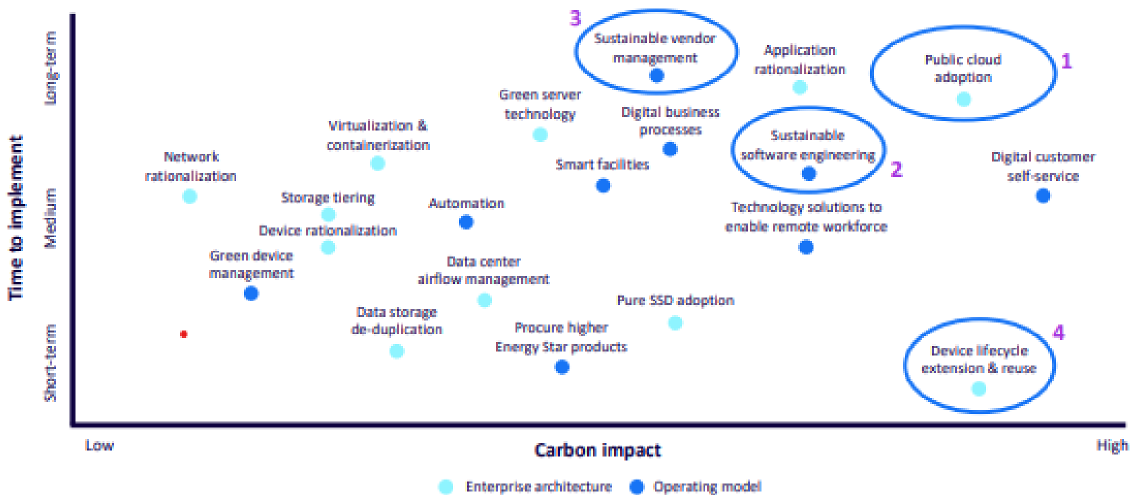


Appendix A-5 Smart City DPI initiatives in the Netherlands

Cities	Smart city initiative with positive impact on SDGs
Amsterdam	Energy Transition: Projects like the Smart Energy Grid and energy-neutral buildings aim to reduce the city's carbon footprint. • The Marineterrein Living Lab: To transform the historic Marineterrein area into a living lab for sustainable urban development and innovation, initiatives include smart energy solutions, sustainability mobility and an innovation hub.
Rotterdam	Climate Adaptation: As a city prone to flooding, Rotterdam has implemented smart water management systems, green roofs, and water plazas to manage excess rainwater. • Port of Rotterdam: Digital technologies are used to enhance the efficiency and sustainability of port operations, including automated logistics and real-time data sharing.
Eindhoven	Living Lab Stratumseind: This project involves the installation of sensors inthe city's nightlife district to monitor and improve public safety and manage crowd behaviour. • Brainport Smart District: A neighbourhood is being developed as a living lab for smart technologies, focusing on energy-neutral homes, smart mobility, and community engagement.
Utrecht	Utrecht Central Station: A major transportation hub seeks to integrate smart technologies to manage passenger flow and enhance the user experience. • Smart Solar Charging: This project involves installing solar panels on rooftops and using the generated energy to charge electric vehicles. The smart charging stations can also feed excess energy back into the grid, optimising the use of renewable energy.
The Hague	Urban Data Center: The Urban Data Center in The Hague collaborates with Statistics Netherlands (CBS) to analyse and use urban data effectively. This helps the city to address challenges like housing, transportation, and publichealth through data insights. • Air Quality Monitoring: The city has installed a network of sensors to monitor air quality in real time. Data from these sensors is used to inform policies and actions to reduce pollution and improve air quality.

Source: Ford C, M Aquila, O Garabova, I Munoz and A Renda, 2025)

Appendix A-6 Example levers to reduce the negative impacts of digitalization on sustainability



Source: Arthur D Little (2023)

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