Redirecting Digital Public Infrastructure

Research Paper

Author:

Venkatachalam Anbumozhi
Director, Research Strategy, and Innovation, Economic Research Institute for ASEAN and East Asia (ERIA)

Institution:

ERIA

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As the concept of Digital Public Infrastructure (DPI) has gained prominence in recent years, governments around the world are currently putting forward new policy initiatives and regulatory frameworks to govern the application of digital technologies and data flows. However, most initiatives disregard the implications of digitalization for environmental sustainability. As the world is facing multiple simultaneous sustainability challenges, several multilateral environmental agreements on climate mitigation, green energy transition, and sustainable consumption have been signed by the global community. These two regimes of policy making are seldom connected and have not systematically addressed the question of what digital public infrastructure means for the Sustainable Development Goals (SDGs). This article outlines the key pathways that can guide the G20 in the use of digital public infrastructure for a deep sustainability transformation, through maximising the environmental benefits of DPI by using a supply chain approach, enhancing smart city applications, promoting growth-oriented business models for big tech companies, and the development of a governance architecture for a DPI-driven low-carbon circular economy.

THE DEVELOPMENT PROMISE AND SUSTAINABILITY PERILS OF DIGITAL PUBLIC INFRASTRUCTURE

The ecosystem for DPI could be visualized at three levels: physical and platform layers, and app-level products. DPI plays a crucial role in ensuring equitable access to resources and fostering innovation in the digital age. Key components of DPI include:

a) Digital identity infrastructure: Secure and universally recognized digital identification systems that enable citizens to access public and private services (GSMA, 2020).
b) Payment infrastructure that facilitates resource transfer with low transaction costs (Ingram, McArthur & Vora, 2022).
c) Data governance and sharing infrastructure: Systems that facilitate the secure and ethical collection, storage, and sharing of data among different stakeholders to promote "data trust" (Davies, 2021).
d) Data exchange infrastructure: Publicly available software and technical standards that facilitate interoperability and collaboration among different digital systems to promote data portability (Flippe & Hassan, 2020).
e) Access Infrastructure: Universal, affordable, and reliable internet connectivity for all citizens (World Bank, 2021).

»That digitalization of public infrastructure can potentially lead to the decarbonization of economies, and positively impact sustainability outcomes, is uncontested.«

f) E-government services: Digital platforms that allow citizens to access government services, such as healthcare, education, and social welfare, online (OECD, 2021).

That the digitalization of public infrastructure can potentially lead to the decarbonization of economies, and positively impact sustainability outcomes, is uncontested. On the other hand, rapid digitalization could also contribute for increased carbon emissions in multiple ways:

Transition to Sustainable Energy: Climate change, food security and energy efficiency are inextricably linked. The International Energy Agency (IEA, 2022) estimates that energy efficiency accounts for 49% of the measures needed globally to stay in line with a 2°C temperature increase scenario (and 56% in the G20 countries). For a sustainable energy transition, the G20 nations need to prioritize renewable energy sources and optimize energy usage, increase energy efficiency, and leverage new and emerging technologies energy. For instance, adoption of smart grids, decentralized energy systems such as microgrids, and community-level renewable systems, can accelerate this transition as well as promote energy democracy. At a micro level, artificial intelligence-powered systems, such as building automation systems that utilize machine learning algorithms to optimize building heating, ventilation, and air conditioning systems, can reduce energy consumption.

»Use of digital communication tools and virtual services can fast track the transition to a sustainable economy.«

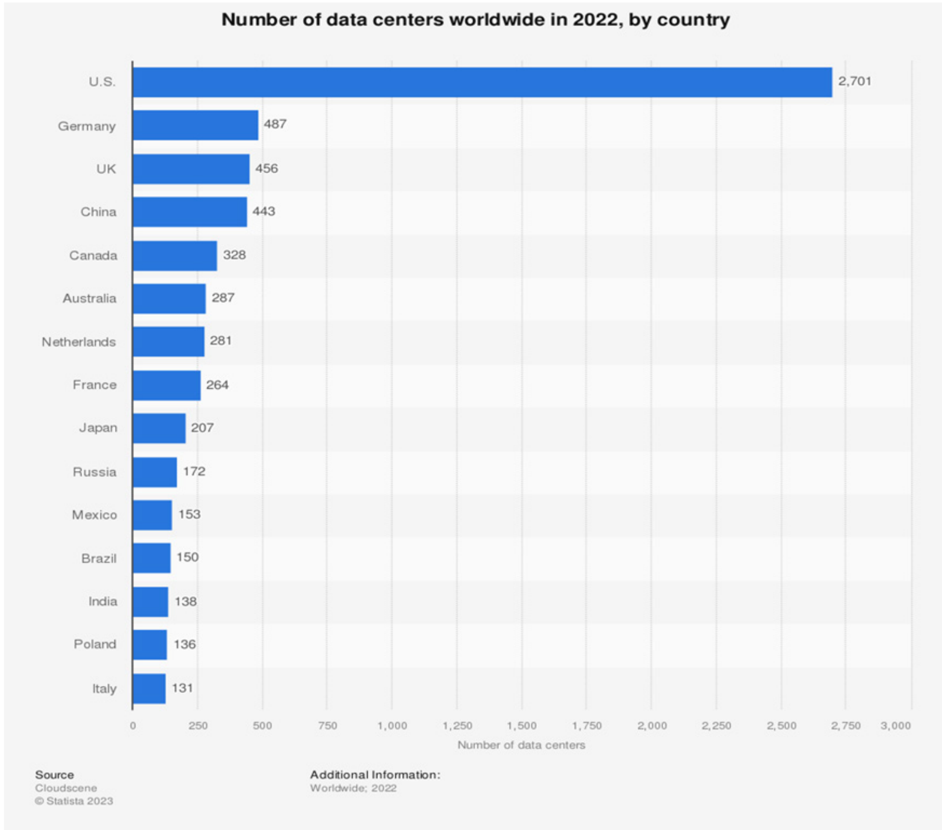
Climate adaptation and resilience: G20 nations account for 80% of all global emissions, making them crucial players in the global efforts to mitigate climate change. On the other hand, the physical infrastructure in the G20 nations is threatened by the impacts of climate change, such as extreme weather events, flooding, and sea-level rise. While the dangers are well recognized, there is not a single accepted pathway to building climate resilience. DPI and attendant technologies can support national and regional level climate adaptation and resilience efforts, for example through early warning systems for natural disasters, drought monitoring systems, and flood management systems. Satellite imagery and remote sensing technologies can track deforestation, monitor air and water quality, and assess the health of ecosystems.

Sustainable Agriculture: Agriculture plays an important role in all economies by contributing to their GDP, employment, and food security. While the exact levels of contribution vary across nations – for example, agriculture contributes 15-18% of India's GDP – there is an urgent need to transition agriculture in the G20 to become both climate-resilient and climate-smart. For example, remote sensing and satellite imagery can be used for weather forecasting and monitoring crop growth, soil conditions, and land-use changes. Smart irrigation systems also allow for real-time monitoring of water usage and water quality, and application of water-saving technologies. Supported by mobile applications, this can help farmers make informed decisions and adopt precision agriculture practices, to optimize crop yields, reduce waste, and conserve resources. Globally, about one-third of all food, approximately 1.3 billion tons, is lost or wasted each year. Blockchain technology may be applied to increase transparency and accountability in agricultural supply chains and reduce wastage.

Finally, industry 4.0 technologies using autonomous and connected systems, artificial Intelligence (AI), cloud computing, and the Internet of Things (IoT) can play a big role in transforming agriculture, making it thrive and facilitate food security. To realize this potential, open data on weather, seed genetics, environmental conditions, and soil data, can play a crucial role in helping the agricultural sector.

Greening Digital Infrastructure: The role of digital infrastructure – both soft

Figure 1: Distribution of Growing Digital Centers Across the Globe



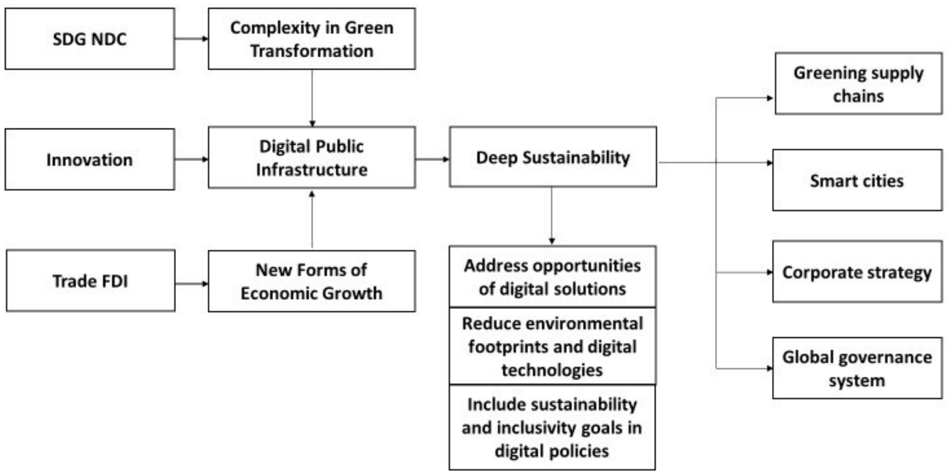
and hard – in promoting economic growth and reducing economic inequality is uncontested. For instance, an AIIB (2022) study indicates that every 10% increase in broadband (3G & above) penetration increases GDP pa in developing countries by 1.38% and doubling broadband speed leads to a 0.3% increase in GDP growth.

However, as digital technology applications increase in scale and complexity, the physical infrastructure on the back end also increases proportionately. Data centers are a good example. As of January 2022, there were over 6300 data centers, almost all of which are in G20 countries. Asia Pacific is the fastest growing region for hyperscale data centers. Data centers are estimated to consume around 1-3% of global electricity demand (Masnet et al., 2021), 0.3 % of global carbon emissions (Andrea & Edler, 2015), use significant amounts of water and produce substantial amounts of e-waste. This number is expected to grow with the increasing reliance on digital technologies.

On the other hand, the use of digital infrastructure can encourage the adoption of energy-saving tools and methods, lowering the carbon footprint. Use of digital communication tools and virtual services can fast track the transition to a sustainable economy. For instance, DPI facilitating remote work, online education, and telemedicine can contribute to lowering environmental impact.

Digital tools can monitor waste generation, collection, and recycling, promoting a circular economy. Further, supply chains can be made transparent and effective with the aid of technologies like blockchain. DPI can aid in the investigation, development, and use of clean technologies and support energy transition efforts. Smart grids, for instance, make it simpler to incorporate

Figure 2: Pathways by which DPI Could Become a Platform for Solutions to Sustainability Challenges



renewable energy sources, and the sharing economy can be supported by appropriate digital platforms. Implementing green ICT policies and standards can potentially offset the negative environmental effects of digital infrastructure.

The rapid advancement of digital technologies has the potential to transform public infrastructure dramatically. For instance, digitalization can increase both the economy's and the government's ability to contribute to a "resilient, sustainable, and inclusive" future. The concept of DPI has acquired prominence in recent years as digital technologies have become increasingly integral to modern societies (Gasser et al., 2020). DPI refers to a set of foundational digital systems and services, often developed and maintained by governments or non-profit organizations, that provide public goods and support the functioning of digital societies (Mansel, 2020).

DPI can be conceptualized as a digital equivalent of traditional public infrastructure, such as roads, bridges, and utilities. It provides essential services that enable the functioning of digital societies and economies, including internet access, digital identity systems, and data repositories (Ndemo, 2021).

Digital tools can facilitate faster and more expansive public engagement, inviting communities to co-design new infrastructure and vote on improvements, while also causing nuanced digital and data governance. Digital technologies can make it easier to gather, analyze, and disseminate environmental data, allowing for better resource management and decision-making.

Digital public infrastructure can help speed up progress on the SDGs by levelling the playing field for an array of service providers using the physical and platform layers of digital infrastructure.

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Figure 2 shows the drivers, opportunities and possible pathways by which DPI can contribute to deep decarbonization. Digital public infrastructure is foundational and cross-cutting. Since verifying an identity or making and receiving a payment are at the core of most transactions, it can create connections for a digital stack, i.e., work in tandem at the policy, process and technology levels will allow sectoral applications to be built on top, and help produce public benefits without public ownership.

The rapid advancement of IoT and fourth industrial revolution technologies have made it possible for governments to transition DPI at scale and with low marginal costs. Some of the related technologies, including robotics, artificial intelligence, decentralized edge computing, advanced analytics, automation, and block chain technology are helping to make such infrastructure more viable and easily scalable.

Despite the advantages outlined above, challenges related to sustainable development will persist. For example, an explosion in digitalization for our industry and economy will lead to an increased reliance on digital networks, platforms, and services. The environmental and social impacts of this are not well studied or understood. Hence, examining the effects of digitalization on sustainability at the local, national, regional, and global levels is crucial as it continues to reshape different facets of society.

POLICY PATHWAYS FOR THE G20 TO HARNESS THE OPPORTUNITIES OF A DEEP SUSTAINABILITY TRANSITION

The G20 member countries in the past have acknowledged the significance of the digital economy and taken action to benefit from it. This includes initiatives such as the G20 Digital Economy Working Group (DEWG), which aims to facilitate collaboration between G20 members in promoting meaningful digital transformation. In the recent past, the Italian and Indonesian presidencies identified digital transformation as a pathway for aiding the post-pandemic economic recovery, as the shifting contours of the global economy into the digital space have opened new frontiers for development in G20 member countries. The Indian presidency has identified four themes focusing on DPI – sharing implementation experiences of digital identity in various countries, sharing of cyber security solutions for MSMEs, use of geo-spatial technologies for infrastructure development and DPI to boost attainment of the SDGs. The G20 Digital Innovation Alliance, launched by Indonesia, also pointed out that future digital technologies and public infrastructure should be built according to regenerative designs that improve economic resilience and foster social equity.

To ensure that the digital public infrastructure delivers a deep transformation to support sustainable transformation, the G20 economies need to work on a set of governing principles. Four areas where digitalization could work for deep sustainability are:

1. Minimizing the environmental impacts of creating, operating, and using digital public infrastructure by incorporating the principles of carbon neutrality, circularity, and eco-efficiency along the global value chains. In this regard, national entitles need to prioritize sustainable procurement policies and establish green procurement policies that prioritize the acquisition of digital products and services that have a lower environmental impact. Implementing policies and regulations that promote sustainable supply chains across industries, including measures to address environmental and social risks in global supply chains, has become imperative.
2. Responsibly opening up and integrating digital technology, data and platform applications that foster low carbon circular economy in smart cities. The incorporation of digital technologies into urban planning and city management can lead to better environmental outcomes. For instance, IoT-enabled sensors and smart grids, etc., make it possible to manage waste, water, and energy more effectively. Digital tools can also improve public transportation systems, resulting in less traffic and lower greenhouse gas emissions. Digital infrastructure, such as GIS systems for mapping, urban heat island analysis, and transportation planning, can be used to create more sustainable, liveable cities. Sustainable mobility analytics, such as real-time traffic and transportation data, can be used to inform urban planning and promote sustainable transportation practices. Eco-friendly fleet management, such as telematics systems for monitoring fuel efficiency and emissions, can be used to reduce the environmental impact of fleet operations.
3. Transforming the growth-oriented business models of big digital tech companies into net zero economic pursuits. The current models focus on setting and enforcing green ICT standards to lessen the environmental impact of digital technologies and advance energy efficiency. Encouraging the adoption of circular economy principles in the digital sector, such as the reuse, repair, and recycling of electronic devices, will be useful in reducing waste and conserving resources. Implementing policies and regulations that encourage responsible device disposal is important. Implementing corporate policies that require the reduction of the carbon footprint of digital infrastructure projects, including data centers, telecommunications networks, and other digital facilities is also warranted.
4. The integration of specific sectoral policies and new oversight institutions is needed to shape future DPI towards deepened sustainability and economic resilience. The growth in DPI, while accelerating the move towards decarbonisation, more efficient data-driven governance and democratic and open governments, also poses several challenges for governments and citizens. Uneven access to digital infrastructure has exacerbated existing inequalities and created new policy and implementation challenges. Underserved communities face barriers to accessing the benefits of digitalization and participating in the digital economy. Independent initiatives that thrive within and across countries, government, private sector, and civil society stakeholders, can result in fragmented approaches on all of the above and consequently lead to sub-optimal sustainability actions. Various policies to promote sustainable innovation can be promoted, including encouraging and supporting innovation in digital technologies, such as the development of low-carbon cloud computing and decentralized

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systems; encouraging cross-sector collaboration among public, private, and civil society stakeholders to develop comprehensive, context-specific strategies for long-term sustainable digitalization; improving data trust, transparency and portability through Open Data Platforms (ODP); and developing ODPs to increase their accessibility and transparency, allowing for more informed decision-making in areas such as climate change, energy, and resource use.

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