BRIDGING ENERGY GAPS WITH DIGITAL SOLUTIONS

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ABSTRACT

Digital technologies can provide off-grid solutions for the millions of people without electricity but progress made over the last decade in expanding electrical grids in least served areas has stalled. This chapter provides the latest data on universal access to energy and funding gaps and discusses ways forward for mobilising urgent investment in physical and digital energy infrastructure to prevent Africa from falling further behind in its digital transformation. In the short term, digital solutions can bridge the gap and offer affordable, clean energy to marginalised, isolated and impoverished communities. In the long term, co-ordination of investments and strategies in digitalisation and energy can enable countries to faster deploy low-carbon, demand-responsive and resilient energy systems.

Key messages

- In a reverse of nearly a decade of progress, the number of people worldwide without access to electricity is set to increase by 2% in 2021, due largely to population growth and impacts of the COVID-19 pandemic in sub-Saharan Africa.
- Digital innovations such as peer-to-peer electricity trading networks and digitally enabled solar electricity units can provide stopgap energy for low-income, remote and other underserved communities.
- Digital and energy transitions should complement one another, with digital technology driving energy efficiency and innovation and a clean and secure energy supply supporting digitalisation.
- Investment in electricity grids, now stalled or inadequate, must be resumed at sufficient scale and speed to overcome the USD 350 billion funding gap to ensure universal access to affordable, reliable energy by 2030.

Emerging and developing economies currently account for around two-thirds of the global population, but only one-fifth of global investments in clean energy (IEA, 2021[1]). To achieve global targets of net zero emissions by the middle of the century, much more investment in electricity grids will need to be mobilised to provide access to clean energy. The COVID-19 pandemic is reversing progress made over the past decade in expanding access, threatening to push Africa, with the least developed energy infrastructure in the world, further behind and jeopardising its digital transformation.

Energy and digital transitions are intertwined: Communities and individuals need reliable, affordable electricity if they are to fully reap the economic, social and environmental benefits of digitalisation. Lack of energy access, by the same token, is one of the drivers of digital inequality. While it will take time and large upfront investments to construct the necessary utility-scale generation and electricity grids to achieve the goal of universal energy access, innovative digital solutions can quickly provide affordable, clean electricity to power development and improve the lives of millions of people who have yet to be connected to an electricity grid.

Efforts to expand energy access are at a turning point

Over the past decade, investments in modernising and expanding electrical grids have increased energy access in Africa. The number of people with no access fell to 580 million in 2019 from the peak of 610 million in 2013. This improvement was largely due to electricity grid construction in Ethiopia, Ghana, Kenya, Rwanda and Senegal,[1] with energy access in Kenya alone expanding from 20% to 85% of the population. Progress has been uneven across the region, however. While Gabon, for example, has improved energy access from 31% to 92% of its population since 2000, only 3% of the population of the Central African Republic and 1% of the population of South Sudan currently have access.[2] Moreover, about 110 million of the people in Africa who still lack access to energy live within distance of connection to the electricity grid but remain unserved due to chronic underfunding of the national grids.

The costs of failing to act and invest are high. In Nigeria, for instance, total energy consumed by diesel and petrol generators for primary energy supply or as backup generation to manage grid blackouts is eight times greater than the total national electricity grid output. Even the inhabitants of the megacity of Lagos rely on backup generators for half of their electricity needs. The opportunity cost of loss of revenue streams to the power utilities and grid operator is estimated to be USD 12 billion per annum, while the fumes from fossil fuel generators in Nigeria contribute to the highest levels of air pollution on the continent and the fourth highest in the world.

Progress towards universal energy access is at a turning point. As of 2020, the global funding gap to achieve energy access for all by 2030, in line with Sustainable Development Goal 7.1, was USD 350 billion, with two-thirds of this spending required in sub-Saharan Africa alone. Meanwhile, the COVID-19 crisis is unravelling the progress already made towards expanding energy access in the region – dampening government investment in electricity grids and leaving a growing number of Africans unable to either afford or connect to reliable, clean electricity – at a time when demand for digital technology is exploding.

The pandemic has set back progress, widening energy and digital divides

The effects of the pandemic on efforts to expand energy access are especially acute in Africa. Globally, the number of people without access to electricity is set to rise in 2021 by 2% over pre-pandemic levels to 770 million people, with 600 million of these in sub-Saharan Africa (Cozzi, Tonolo and Wetzel, 2021[2]). In addition, 30 million people in the region who previously had access to electricity in 2019 – 6% of the connected population – may no longer be able to afford basic electricity services (IEA, 2020[3]). These setbacks make it all the more urgent to reverse the decline in access to energy, given that population growth and ongoing digital transformation will mean that more people will need access to reliable, clean electricity to avoid being further disadvantaged.

Increased digital demand calls for co-ordinating new energy and digital infrastructure

The number of Internet users worldwide has doubled over the past decade and global Internet traffic has grown by more than fifteen-fold (ITU, 2021[4]; Cisco, 2018[5]; IEA, 2021[6]). However, energy use from

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digital technologies has remained relatively flat thanks to strong energy efficiency improvements (Malmodin and Lundén, 2018[7]). Global data centre energy use, for example, has been steady at around 1% of global electricity use since 2010, despite a more than sevenfold increase in demand for data centre services (Masanet et al., 2020[8]; IEA, 2021[6]). And while overall Internet traffic grew by over 40% in 2020, several large network operators have reported the same or lower electricity use (Koomey and Masanet, 2021[9]).

Demand for data and digital services is expected to continue its exponential growth over the coming years, both in terms of users and the data intensity of applications. The number of mobile Internet users is projected to increase from 4 billion in 2020 to 5 billion by 2025, while the number of Internet of

Things connections is expected to double to 24 billion (GSMA, 2021[10]). New data centres and network infrastructure will be needed to accommodate strong demand growth, particularly in developing countries. Serving this expanding user base will require new, local infrastructure and effective policy to ensure data sovereignty and service quality.

New digital and energy infrastructure can complement one another and drive energy efficiencies. To limit greenhouse gas emissions from new digital infrastructure projects, for instance, regulators can require that new data centres be fully powered by renewable energy through on-site generation or matched through power purchase agreements.[3] Despite concerns that the rapid growth of data centres and networks in developing countries could overstretch underdeveloped energy systems, preliminary market research suggests that new data centres are more likely to be located near urban centres that have more developed electricity infrastructure rather than in rural areas where energy access rates are especially poor. In rural areas, new mobile data transmission network infrastructure and services may also promote inclusive development by enabling access to energy outside traditional electricity grids for isolated or unserved communities through new business models.

Inclusive, people-centred digital solutions can bridge electricity gaps

Digital technology can help mitigate the challenges around lack of access to a traditional electricity grid, unlocking new business models and equipping isolated and vulnerable communities and individuals with affordable clean energy solutions. Digitally enabled mobile communications technology especially plays a crucial role. Mobile banking and payments, for instance, unlock new business models for people without access to affordable electricity. Innovative, people-centred approaches also can help ensure that energy and digital transformations are inclusive, positively address gender equity and explicitly include access provision for marginalised groups.

As demand for electricity in OECD countries has increased about 15% since 2000, Africa's electricity consumption has almost doubled in the same period,[4] with digitally enabled solutions increasingly helping to meet the growing demand. Across Africa, about 4.3 million pay-as-you-go (PAYG) solar home electricity systems were installed in 2020 alone (GOGLA, 2020[11]), providing clean energy solutions for people in urban, peri-urban and rural areas unserved by power grids. These units, enabled by smart meters and two-way digital communication, allow customers to spread out their payments in small instalments over time, according to their consumption, thus avoiding a high upfront lump sum for service. Such small-scale digital solutions have also proven useful in humanitarian situations: displaced persons in the Kakuma refugee camp in northwest Kenya, for instance, gained access to electricity thanks to the installation of 1 000 PAYG solar home systems (Casswell, Sharma and Khan, 2019[12]). As these systems do not depend on traditional grid infrastructure, low-income customers can leapfrog traditional providers and install renewable energy and efficient technologies in their dwellings.

Another example is the SOLshare project in Bangladesh, where 75% of the population lives in rural areas but fewer than 30% of rural residents have secure energy access. In the world's first digitally enabled peer-to-peer electricity trading network for rural households, people with a PAYG solar home system can use a digital platform to sell excess clean electricity to their neighbours, further reducing reliance on fossil fuel-powered generators or kerosene lamps. SOLshare, which has installed more than 70% of the home systems, estimates that Bangladesh alone could have as many as 20 000 digital peer-to-peer nanogrids supplying 1 million people by 2030 (UN, 2021[13]).

Development of battery storage to hold excess energy produced during the day would help scale up nanogrid P2P energy trading technology. For instance, lithium battery cells from electric vehicles are suited to stationary power storage even after the useful life of the vehicle (Engel, Hertzke and Siccardo, 2019[14]) and could be used effectively in nanogrid and microgrid applications. Larger microgrids with more connected properties and larger solar installations offer improved system resilience and efficiency. Given that microgrids can be up and running in as little as two months (Shah and Chandrasekaran, 2020[15]), they have enormous potential to power development and provide useful energy to support businesses, schools and healthcare services. This is especially important in sub-Saharan Africa where, according to the World Health Organization, only about 30% of healthcare facilities have access to reliable electricity (Stottlemyer, 2020[16]).

Improving energy and digital transitions: The way forward

Digital technologies can help bridge the gap and provide energy solutions for people and communities who have no access to electric grids and lack basic electricity services. Development finance can be instrumental in scaling energy access; for example, the African Development Bank mobilised EUR 24 million in 2018 that partially guaranteed local financing to supply power to 100 000 rural households in Côte d'Ivoire (Ahouassou, 2018[17]). National and international actors can ensure digital and clean energy transitions that emphasise efficiency, inclusion and affordability.

- The International Energy Agency's Global Commission on People-Centred Clean Energy Transitions[5] has proposed 12 recommendations to influence the clean energy policies and programmes of governments, funders, investors and international organisations engaged globally in energy transitions. These recommendations encourage actors to consider the social and economic impacts on communities and individuals, including gender equity and social inclusion, the creation of decent jobs, and ensuring worker protection when approaching how energy is produced, used and the technologies involved to ensure the overall success of clean energy transitions on the path to net zero (IEA, 2021[18]).
- By sharing best practices on policy design and implementation, policy makers can better integrate fairness and inclusivity in both digital and energy transitions and take measures to ensure that digital technologies are deployed in ways that promote a just and equitable net zero transition.
- Improving energy efficiency can help reduce the demand for energy in developing countries. However, real-world data on energy use by data transmission networks and data centres are scarce, making it impossible to provide robust estimates of the current and projected energy use or their impact on local grids and energy access. To ensure a sustainable and equitable build-out of digital infrastructure, policy makers should ensure that such data are collected and publicly reported.

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NOTES

1. For details, see: https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity.
2. See: https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity.
3. A power purchase agreement is a contractual agreement between energy buyers and sellers. It is becoming more commonplace for large corporate consumers to purchase directly from renewable energy generators to decarbonise their electricity supply in long-term 10- or 20-year contracts to reduce exposure to price volatility.
4. For details, see: https://www.iea.org/data-and-statistics/data-browser?country=WEOAFRICA&fuel=Energy%20consumption&indicator=TotElecCons.
5. For more information on the programme, see: https://www.iea.org/programmes/our-inclusive-energy-future.

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