Research Report on “Africa’s Digital Transformation: Sustainable Energy for Data Centres –Led Digital Development”

Contents

Chapter 1 Introduction **1**
1.1 Background and Rationale **1**
1.2 Objectives and scope **3**
1.3 Approach **4**
1.4 Structure of the paper **4**
Chapter 2 Global Trends in Data Centres and Energy Demand **5**
2.1 Global data centre growth and capacity expansion **5**
2.2 Data Centre-Driven Electricity Demand and Power Intensity **6**
2.2.1 Current and projected global electricity demand *6*
2.2.2 AI, rack density and changing power requirements *6*
2.3 Emerging Pathways for Sustainable Data Centre Development **7**
Chapter 3 Africa's Data Centre Ecosystem **11**
3.1 Market Overview and Landscape **11**
3.2 Governance and Barriers **13**
3.3 Outlook to 2030 ..... **14**
Chapter 4 Energy Requirements and Infrastructure Needs **16**
4.1 Data-Centre Energy Demand and Load Requirements **16**
4.1.1 Electricity requirements by data-centre scale and type *16*
4.1.2 Sources of facility electricity demand *17*
4.1.3 Current and projected African electricity demand *18*
4.2 Power-System Readiness and Grid Implications **19**
4.2.1 Generation adequacy and electricity availability *19*
4.2.2 Grid reliability, transmission and distribution *20*
4.2.3 Electricity affordability and cost competitiveness *20*
4.2.4 Grid interconnection and implications for system planning *21*
4.3 Power-Supply Models, Resilience and System Integration **21**
4.3.1 Grid-connected renewable-energy procurement *21*
4.3.2 Captive, off-grid and mini-grid-based data centres *22*
4.3.3 Storage, backup power and resilience *23*
4.3.4 Regional power pools and cross-border electricity supply *23*

4.3.5 Energy additionality and system integration 24
4.4 Energy Efficiency, Cooling and Resource Requirements 24
4.4.1 Energy efficiency and facility performance 25
4.4.2 Cooling requirements by scale and technology 25
4.4.3 African climatic conditions and cooling implications 26
4.4.4 Water requirements and resource efficiency 26
4.4.5 Non-water or low-water cooling technologies 26
4.5 Data-Centre Energy Readiness and Priority Infrastructure Needs 27
4.5.1 Data-Centre Energy Readiness Assessment Framework 27
4.5.2 Priority infrastructure gaps and country typologies 28
Chapter 5 Policy, Regulatory and Investment Landscape 29
5.1 Policy and regulatory considerations to advance energy for data centers 29
5.1.1 Private investment in the grid system 29
5.1.2 Regulatory barriers to captive power investment 30
5.1.3 Off-grid power integration 31
5.1.4 Productive use of energy 31
5.1.5 Integrated planning, siting and connection 32
5.1.6 Energy efficiency, water and environmental performance 32
5.1.7 Cost allocation, tariffs and protection of other consumers 33
5.2 Towards an investment climate for data centres in Africa 33
5.2.1 Business models for energy investments for data centres 33
5.2.2 Public–private partnership models 34
5.2.3 Power purchase agreements and contractual models 34
5.2.4 Private investment in energy models 35
5.2.5 Self-consumption business models 36
5.2.6 Mini-grid business models 36
5.2.7 Productive use of energy business models 37
5.2.8 Regional power pooling and regional data centres 37
Chapter 6 Socioeconomic and Environmental Implications 38
6.1 The economics of data centers in Africa 38
6.2 Economic Benefits and Domestic Value Creation 39

6.3 Social Inclusion and Distributional Implications 39
6.4 Economic Trade-offs, Environmental Impacts and Sustainability 40
6.4.1 Energy-access and economic opportunity costs 40
6.4.2 Carbon emissions and energy footprint 41
6.4.3 Water use, land and e-waste 41
6.4.4 Managing economic and environmental trade-offs 42
Chapter 7 Pathways for Sustainable Data Centre Development in Africa 44
7.1 Context 44
7.2 Measures/pathways for a resilient and competitive data centre 44
7.3 Policy priorities and stakeholder responsibilities 46
7.4 Conclusion 47
Chapter 8 Conclusion and Roadmap 48
8.1 Recommendations 48
8.1.1 Member States (ministries of energy, digital economy, finance and investment) . 48
8.1.2 Energy regulators 48
8.1.3 Utilities and system operators 48
8.1.4 Regional economic communities, power pools and regional regulators 49
8.1.5 African Union Commission, AUDA-NEPAD and continental institutions 49
8.1.6 Economic Commission for Africa 49
8.1.7 Development finance institutions and partners 49
8.1.8 Data-centre operators and investors 49
8.2 Key observations and conclusions 50
References 51

Chapter 1 Introduction

1.1 Background and Rationale

The rapid adoption of digital technologies, including cloud computing, e-commerce, artificial intelligence (AI), the Internet of Things (IoT), and cryptocurrencies, is driving unprecedented demand for data centres worldwide. As a result, the global data centre market is projected to grow from about US$242 billion in 2024 to over US$580 billion by 2032 (Fortune Business Insights, 2025). At the same time, data centres consumed an estimated 460 TWh of electricity in 2022, accounting for approximately 2 % of global electricity demand, with consumption projected to more than double to 945 TWh by 2030 (International Energy Agency [IEA], 2025b). This growth is raising concerns about carbon emissions, energy security, and the environmental footprint of digitalization.

In Africa, this global shift is driving rapid growth in demand for digital infrastructure**.** The African data center market is projected to grow from about $3.49 billion in 2024 to nearly $6.81 billion by 2030, at a compound annual growth rate of roughly 11.8%, driven by increased internet usage and cloud adoption (GlobeNewswire, 2025). Africa's total data centre capacity is also projected to reach approximately 1.2 gigawatts (GW) by 2030, representing substantial growth from current levels (African Data Centres Association [ADCA], 2026a). Nevertheless, except in South Africa, where the most mature data centre market has approximately 74% of its capacity already utilized, currently deployed IT capacity in the rest of Africa represents only about one-third (33%) of total market potential, indicating significant room for expansion (ADCA, 2026a).

Recent AI developments and digital value creation present significant opportunities for future investment. Data centre projects accounted for more than 20% of global greenfield FDI in 2025, demonstrating their increasing strategic importance (United Nations Conference on Trade and Development [UNCTAD], 2026). Accordingly, investors have increased African data centre capacity investment by approximately two-thirds (67%), indicating the rapidly growing demand for digital infrastructure (ADCA, 2026a).

In order to capitalize on increasing data center investment levels, there is a need to invest in local data infrastructure to ensure that data generated within the continent remains under local governance, strengthening regional autonomy and digital sovereignty. The concentration of cloud and data infrastructure markets in high-income countries leaves many African countries with limited access to affordable data centers, cloud services, reliable broadband, and computing capacity needed for advanced analytics and AI.

In addition, there exist risks of unequal value capture, where data flows outward while innovation, profits, and digital capabilities remain concentrated in a few global technology hubs (Organisation for Economic Co-operation and Development [OECD], 2019). The continent currently accounts for only about 0.6 % of global data centre capacity, with approximately 360 MW active, alongside 238 MW under construction and 656 MW planned (ADCA, 2026a). Despite this progress,

capacity remains concentrated in a small number of markets, with South Africa, Kenya, Nigeria, and Egypt accounting for nearly 46 % of the continent's total, indicating that data center deployments on the continent are unevenly distributed and revealing regional imbalances that could undermine equitable digital sovereignty across the continent (TheCable, 2025).

To address these challenges, Africa requires a substantial expansion of data centre capacity to meet future needs. Africa's data centre capacity will require approximately US$4–7 billion of investment every year, demonstrating the scale of capital required to close the continent's digital-infrastructure deficit (Minges, 2024). The expansion of data centres, however, cannot be separated from Africa's electricity challenge since data centres require large amounts of continuous and reliable electricity. As of 2024, approximately 600 million people, around 47% of the region's population, have no access to electricity (IEA, 2025f). The scale of data centre electricity demand makes this existing energy deficit particularly important for Africa.

According to the IEA (n.d.), a traditional data centre typically requires approximately 10–25 MW of power, while the electricity demand of a hyperscale AI data centre can exceed 100 MW. A 100 MW hyperscale AI data centre can consume approximately as much electricity as 100,000 households, demonstrating the potential impact that individual large facilities can have on national and regional electricity systems (IEA, n.d.). Against a global backdrop in which data centre electricity consumption is projected to increase from approximately 485 TWh in 2025 to 950 TWh by 2030, Africa therefore has an opportunity to develop its emerging data centre industry differently by linking new digital capacity directly to new renewable generation, grid investment, energy storage and energy-efficient infrastructure (IEA, 2025c). enabled by captive, productive use of energy and system-integrated business models. Yet realizing this potential will depend on overcoming several interrelated energy constraints, including the following:

- **Limited investment in energy infrastructure:** Data centre growth requires reliable grids, adequate generation capacity, and possibly strong regional interconnections, yet investment remains insufficient. About US$64 billion per year from 2023 until 2030 is needed in the power sector in Africa (African Development Bank [AfDB], 2025). Furthermore, Africa captures about 2% of global clean energy investments (IEA, 2025d).
- **Insufficient electricity supply:** In many African countries, generation capacity falls short of demand, while data centres require continuous, high-capacity power. The region added about 42 million electricity connections annually between 2022 and 2024, but rapid population growth meant that the number of people without access declined by only around 4 million per year (World Bank et al., 2026).
- **Frequent outages and unreliable grids:** Recurring power cuts compel operators to invest in backup generation and battery storage, substantially raising operating costs. World Bank enterprise data indicate that about 72 % of firms in sub-Saharan Africa experience electrical outages, highlighting the reliability risks facing power-intensive facilities. Furthermore, firms experienced an average of 7.6 outages per month, each lasting about 1.9 hours (Solis, 2025).

- **High energy costs:** Electricity prices vary across the continent and based on the underlying generation source and efficiency of the transmission and distribution infrastructure; however, overall, they remain high, weakening the competitiveness of African data centres.
- **Dependence on fossil fuels:** In several countries, operators still rely heavily on diesel generators to maintain service, leading to high costs, substantial CO_2 emissions, and exposure to fuel-price volatility. In at least 14 countries, electricity generation from oil products accounted for nearly half of electricity generation.
- **Rising demand from artificial intelligence:** The growth of AI, cloud computing, and large-scale data processing is rapidly increasing the energy needs of digital infrastructure. Africa's data centre electricity demand is projected to grow by about 9 % annually and could reach roughly 2 GW by 2030, intensifying pressure on already constrained power systems (IEA, 2025b).
- **Cooling challenges:** High temperatures across much of the continent increase cooling needs, driving up energy consumption and, in some cases, water use. Data centers further require significant energy for cooling, depending on the applied cooling technology. The cooling share of total data center electricity consumption ranges from highly efficient 7-15% to less efficient centers as high as 30% (IEA, 2025b).

1.2 Objectives and scope

This paper aims to help member States design rules and transactions that allow data-centre investment to finance new electricity supply and network capacity, allocate costs clearly and generate wider development benefits. It addresses grid-connected, captive, hybrid and off-grid supply arrangements, as well as cross-border supply through regional power pools. It will examine the energy requirements, sustainability pathways, and policy conditions needed to support data centre-led digital transformation in Africa. It will generate practical recommendations and develop continent-wide guidelines on energy efficiency, environmental sustainability, and digital security.

The paper is intended for:

- ministries responsible for energy, the digital economy, finance and investment;
- electricity regulators, utilities and system operators;
- investment promotion agencies;
- regional economic communities, power pools and regional regulators;
- continental institutions;
- development finance institutions;
- data-centre and energy investors.

The measures are not a single template. National authorities should adapt them to the condition of their power systems, their electricity laws and the services a proposed facility will provide.

1.3 Approach

The analysis draws on the following sources:

- a review of international and African literature on data-centre energy demand and power-sector reform;
- the regulatory instruments of selected member States, including Kenya, Morocco, Nigeria and South Africa;
- publicly disclosed project information;
- industry data from the Africa Data Centres Association and others.

It will be complemented by the case-study programme and by consultations with member States and stakeholders. Figures are drawn from the sources cited and should be updated as new data become available. Because many data-centre and energy transactions are confidential, several observations rely on operators' public statements and specialist press reporting, which are identified as such.

1.4 Structure of the paper

Chapter 1 presents the background and rationale of the report. Chapter 2 presents the global and African context. Chapter 3 reviews the current state and growth prospects of Africa's data-centre ecosystem. Chapter 4 analyses the energy implications of its expansion. Chapter 5 examines the policy, regulatory and investment environment shaping data-centre development in Africa. Chapter 6 assesses how the resulting benefits, costs and environmental pressures are distributed.

Chapter 2 Global Trends in Data Centres and Energy Demand

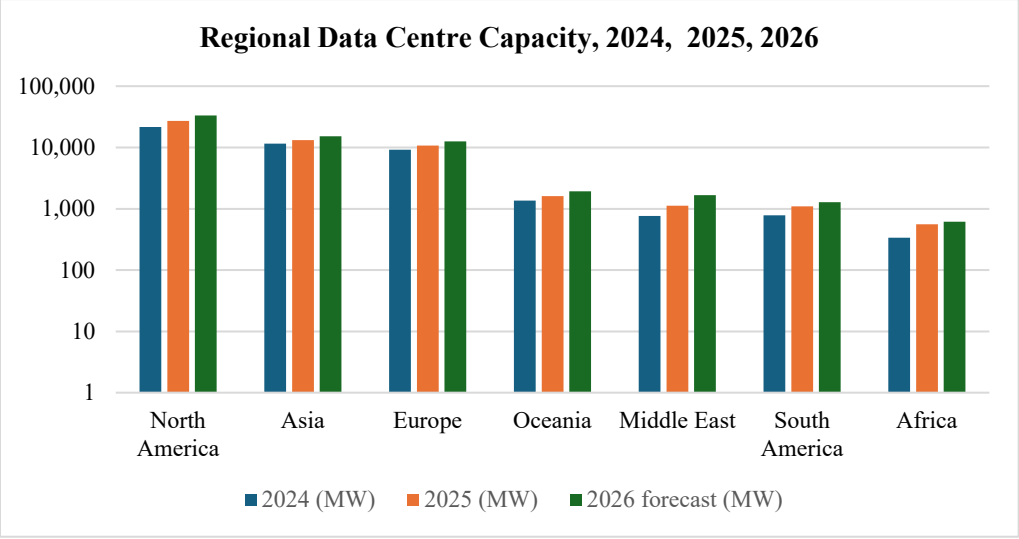
The chapter reviews global trends in data-centre development and energy consumption, examines emerging approaches to sustainable data-centre operations, and highlights lessons and good practices for sustainable data-centre development, including renewable energy integration, energy-efficiency measures, and innovative cooling technologies that may inform Africa's efforts to expand digital infrastructure while advancing sustainable energy development.

2.1 Global data centre growth and capacity expansion

The global data centre industry is expanding rapidly, driven by increasing demand for artificial intelligence (AI), cloud computing, and digital services. Global installed data centre capacity is projected to increase from 103 GW in 2025 to 200 GW by 2030, representing approximately 94% growth, with an estimated US$3 trillion in investment required to support this expansion (Jones Lang LaSalle [JLL], 2026). Similarly, the number of operational hyperscale data centres increased from 1,136 in 2024 to 1,360 in 2025, reflecting the growing importance of large-scale digital infrastructure (Synergy Research Group [SRG], 2025, 2026). By the end of 2025, hyperscale facilities accounted for 48% of global data centre capacity, followed by enterprise on-premises facilities (32%) and non-hyperscale colocation facilities (20%).

The hyperscale share is projected to reach 67% by 2031, highlighting the continuing shift toward large-scale cloud and AI infrastructure (SRG, 2026). **Figure *I*** presents the regional data centre capacity across regions from 2024 to 2026.

Figure I Regional Data Centre Capacity, 2024-2026.



***Source**: **Knight Frank.** (2025). Data centres global report 2025.*

***Note**: There is a difference in the data center capacity numbers reported depending on the source.*

At the regional level, global data centre capacity expanded significantly between 2024 and 2025, driven by increasing demand for AI, cloud computing, and digital infrastructure. In 2025, North America led with 27,251 MW, followed by Asia (13,225 MW) and Europe (10,797 MW), while

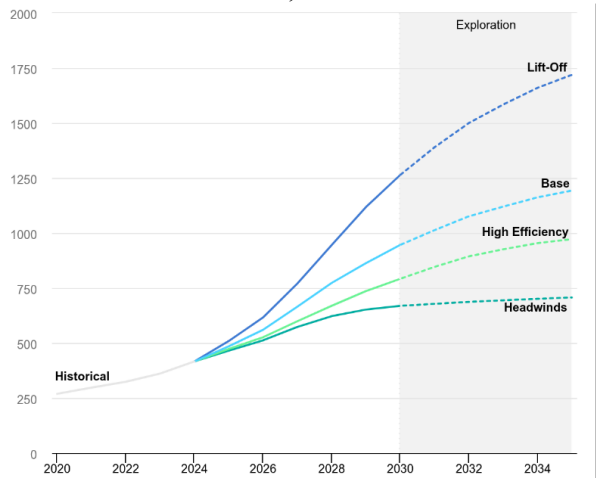
Africa recorded the lowest capacity at just 558 MW (Knight Frank, 2025). Despite this disparity, Africa recorded the highest annual growth rate (65.1%), followed by the Middle East (46.5%), South America (38.7%), North America (25.7%), Oceania (17.7%), Europe (17.6%), and Asia (14.4%). However, Africa's capacity is projected to reach only 615 MW by 2026, compared with 33,316 MW in North America, highlighting persistent regional disparities and the need for greater investment in Africa's digital infrastructure (Knight Frank, 2025).

2.2 Data Centre-Driven Electricity Demand and Power Intensity

2.2.1 Current and projected global electricity demand

The rapid expansion of digital technologies, cloud computing, and artificial intelligence (AI) is transforming data centers into increasingly important components of global electricity demand. Although the electrical efficiency of data centers has improved over the years due to technological advancements, the increase in demand for data centers, together with the exponential growth of AI usage, has made total electricity consumption surge rapidly, outpacing improvements in efficiency. In 2025 alone, electricity demand from data centers increased by about 17%, over five times the 3% growth seen in global electricity demand across all sectors (IEA, 2025a). Data center electricity consumption is expected to grow from an estimated 485 TWh in 2025 to more than double to 950 TWh by 2030 (IEA, 2025c). This growth is raising concerns about energy security and the environmental footprint of digitalization. At the same time, the lack of reliable energy is becoming one of the main bottlenecks to data center development and expansion. The plot shown in **Figure II** shows the global electricity consumption of data centers starting from 2020 and their projected consumption up to 2035.

Figure II Global electricity consumption (in TWh) of data centres, 2020-2035.



Source: **International Energy Agency (IEA).** *(2026a). Electricity consumption by data centres, 2020-2035*

2.2.2 AI, rack density and changing power requirements

As can be seen in **Figure II**, the linear increase in data centers' electricity demand has changed into exponential growth after the widespread adoption of AI use by the public from 2022 onwards. To keep up with the ever-increasing demand for better computing capabilities, companies at the forefront of AI development are adopting high-density computing equipment. Currently, the average rack density of all data centers sits at 11 kW, with some AI-focused facilities pushing upwards of 100 kW (Uptime Institute, 2026). Rack density, which indicates the amount of electrical power and computing hardware packed into a single server rack measured in kilowatts (kW) per rack, will continue to rise as more and more AI and GPU servers are deployed. Between 2020 and 2025, the power density of AI servers increased by 11 times (IEA, 2025c). In 2025,

electricity consumption of AI-focused data centers alone increased by about 50% and is expected to triple by 2030 (IEA, 2025a). Development of data centers, therefore, is increasingly an energy planning issue, not solely a digital infrastructure issue focused on telecommunications.

Higher computing density also increases the amount of heat generated within a relatively small physical space. Thus, maintaining appropriate operating temperatures is becoming a critical aspect of data center design. According to the IEA (2025b), cooling represents approximately 7% of electricity consumption in highly efficient hyperscale data centers but can exceed 30% in less-efficient enterprise facilities. Compared to conventional air-cooling systems, advanced cooling approaches such as direct-to-chip cooling, two-phase cooling, and other liquid-based thermal management technologies remove large amounts of heat, making them ideal for high-density computing equipment. However, the effectiveness of these technologies is dependent on multiple factors such as equipment compatibility, local environmental conditions, installation costs, and maintenance requirements.

Beyond the increase in power demand from data centers, AI training and inference can produce rapid variations in electricity demand, which can be challenging for effective and reliable power distribution. Energy storage, advanced electrical infrastructure and improved power management systems are therefore becoming increasingly important for maintaining stable operations. Based on IEA's estimates, 20-25 gigawatts (GW) of battery storage power capacity could be installed globally by 2030 to ensure stable operation of data centers (IEA, 2025b). At the same time, technological advances in energy efficiency, renewable energy integration, and power management could create opportunities to develop more sustainable computing infrastructure.

2.3 Emerging Pathways for Sustainable Data Centre Development

The rapid expansion and rising power intensity documented in the preceding sections are translating into grid congestion, longer interconnection timelines and growing pressure on energy systems. Sustainable data-centre development therefore requires a coordinated shift from capacity expansion alone towards efficient computing, resilient power supply and infrastructure planned around local energy, water and network constraints. These global cases illustrate the emerging pathways through which countries and operators are responding to the energy, infrastructure and resource pressures associated with data-centre growth. **Table I** consolidates the principal approaches, performance benchmarks and levels of global maturity expected through 2030, while **Table II** presents the emerging technological advancements and case studies for emerging best practices.

Taken together, these global pathways provide a practical reference for aligning data-centre expansion with energy security, resource efficiency and climate objectives. Their relevance to Africa, however, will depend on the continent's distinct market conditions, infrastructure readiness, renewable-energy resources and regulatory capacity. The next chapter examines Africa's Data Centre Ecosystem and the opportunities and constraints shaping its sustainable development.

Table I Principal approaches, performance benchmarks and levels of global maturity.

Global Trend / Driver	Energy & Infrastructure Impact	Sustainable Pathway / Technology	Key Metrics & Operational Targets	Example Countries (Projects)	Source
AI & High-Density Workloads	Thermal Design Power (TDP) exceeding 40kW–100kW+ per rack, rendering legacy air-cooling inefficient.	Direct-to-Chip Liquid & Immersion Cooling	Target PUE < 1.15; up to 90% reduction in cooling power demand.	USA (US Hyperscalers), China (Alibaba Cloud / Zhangbei campus), Japan.	IEA Energy & AI Report (2025/2026); Uptime Institute Global Data Center Survey.
Grid Connection Bottlenecks & Baseload Strain	Transmission line queues (5–7 year delays) and reliance on fossil-fuel peaker plants.	On-site Microgrids, BESS, Clean Power Purchase Agreements (PPAs), & SMRs	24/7 Carbon-Free Energy (CFE) matching; multi-MW Battery Energy Storage.	USA (Virginia grid expansion), Ireland (Dublin microgrids), Kenya (Geothermal PPA parks).	International Energy Agency (IEA) Data Centre Electricity Trends (2025); World Bank Group.
Water Scarcity & Evaporative Cooling Risks	High municipal water consumption in drought-prone or arid data centre clusters.	Closed-Loop Dry Cooling & Industrial Wastewater / Desalination Reuse	Target WUE ≈ 0 L/kWh; 100% recycled industrial water standard.	USA (Arizona / Nevada facilities), Spain, South Africa (Teraco chilled systems).	United Nations University Institute for Water, Environment and Health (2026); EU Energy Efficiency Directive (EED).
Thermal Waste & Low Energy Reuse	Over 90% of electricity consumed is converted to low-grade waste heat rejected into the atmosphere.	Waste Heat Recovery & Municipal District Heating Integration	Energy Reuse Factor (ERF) > 0.30; heat export at 40°C–55°C.	Finland (Hamina campus heat reuse), Denmark (Fredericia district system), Germany.	Nordic Energy Research; EU Energy Efficiency Directive (EED) Reporting Framework.
Carbon & Hardware Lifecycle	Embedded carbon in server hardware and short 3–5 year hardware refresh cycles.	Circular Hardware Design, Server Refurbishment, & Low-Carbon Building Materials	Scope 3 Reduction; >80% e-waste recycling; server lifespan extension to 5+ years.	Netherlands, United Kingdom, Singapore (Sustainable Data Centre Standard).	ITU-T L.1300 Series (Green Data Centres); Circular Electronics Partnership (CEP).

Table II Technological advancements and case studies for emerging best practices.

Global emerging pathways for data center	Country and current approach	Lessons and Best practices demonstrated
1. Tropical liquid colling and higher-temperature operation	**Singapore:** has launched the world's first standards for tropical data centres, SS 715:2025 and SS 726:2026, promoting energy-efficient IT equipment and liquid cooling that can cut data-centre energy use by over 30%, while supporting its Green Data Centre Roadmap target of at least 300 MW of additional near-term capacity (IMDA, 2024).	Sustainability standards should reflect local climatic conditions. Singapore's standards address tropical heat, humidity, corrosion, water use and the integration of liquid cooling with existing air-cooled infrastructure.
2. Waste-heat recovery through district-energy systems	**Netherlands:** is advancing data-centre heat recovery, including an Amsterdam-port project by Vattenfall Heat NL and SilverFalcon DC designed to supply 25 MW to a district heating network using a high-temperature heat pump, although heat availability, infrastructure costs, subsidies, and complex contracts remain key challenges (Euroheat & Power, n.d.).	Waste-heat reuse depends on heat availability, nearby demand, infrastructure investment, financial viability and long-term contractual arrangements. The Amsterdam case identifies these as important implementation challenges.
3. Conditional grid access tied to generation, storage and renewables	**Ireland:** introduced a connection policy under which new data centres are required to provide generation and/or storage capacity, on-site or locally, corresponding to requested maximum import capacity. The capacity must participate in the wholesale market. New facilities are also required to meet at least 80% of annual demand with additional renewable-electricity projects in Ireland (CRU, 2025).	Electricity systems face capacity constraints, connection policy can require large data-centre loads to contribute generation, storage or additional renewable electricity. Ireland requires new data centres to provide generation or storage corresponding to requested import capacity and to meet at least 80% of annual demand with additional renewable projects in Ireland.
4. Geothermal power and underground thermal storage	**United States:** energy authorities identify geothermal generation and cold underground thermal-energy storage as potential data-centre pathways. The U.S. Department of Energy notes that geothermal generation commonly has a capacity factor of about 90%, while cold underground thermal storage could reduce peak cooling electricity demand (DOE, n.d.-b).	Firm geothermal generation and thermal storage are potential pathways where suitable resources exist. The U.S. Department of Energy identifies geothermal generation and cold underground storage as potential data-centre energy and cooling solutions.
5. AI-controlled flexible cooling with thermal storage	**Denmark:** Cool-Data project is developing modular cooling integrated with phase-change thermal storage and an AI-based controller. The system is intended to respond to real-time inputs and support flexible use of lower-cost, lower-carbon electricity and waste heat. The project is being tested at industrial sites (DTU, n.d.).	Cooling and thermal storage can be operated flexibly in response to electricity costs and carbon intensity. Denmark's Cool-Data project is testing this approach at industrial sites; its projected benefits should be distinguished from independently verified operating results.
6. Transparent environmental reporting and	**The European Union** has established a reporting framework and the first phase of a common rating scheme for data centres. The European Commission identifies energy consumption, water use, carbon emissions, renewable energy, waste-heat reuse and grid	Comparable reporting can improve transparency around data-centre energy use, water consumption, renewable electricity, waste-heat reuse and grid interaction. The

	common rating systems	interaction as relevant sustainability issues (European Commission, 2026).	EU has established the first phase of a common rating framework.
7.	**Modular, hybrid and anchor-backed emerging-market development**	Emerging-market experience across **Malaysia, India, Brazil, South Africa and Türkiye** shows growing interest in hybrid energy systems, modular expansion and differentiated deployment models, including hyperscale, colocation and edge facilities. The Atlantic Council identifies grid reliability, electricity prices, connectivity, regulation, supply chains and workforce readiness as central risks (Atlantic Council, 2026).	Emerging-market development needs to consider grid reliability, electricity prices, connectivity, permitting, supply chains and workforce readiness. Modular expansion and hybrid energy strategies can help address some of these constraints.
8.	**Renewable-energy parks integrating data centers and power infrastructure**	**Ireland:** is also developing a Green Energy Park model. The Arklow project is described as combining the DUB20 data centre, a shared 220 kV substation, connection to the planned 800 MW Arklow Bank Wind Park 2, on-site solar, battery storage and other grid-supporting infrastructure (Energy-Pedia, 2025).	Data-centre design can exploit local renewable resources and climatic conditions. The atNorth case uses renewable electricity and direct free cooling designed for Iceland's cold, windy and rainy environment.
9.	**Immersion cooling for high-density computing**	**Japan**: has tested immersion cooling at KDDI's Oyama Network Center. The demonstration by KDDI, Mitsubishi Heavy Industries and NEC Networks & System Integration reported a 94% reduction in server-cooling energy compared with conventional cooling and achieved a PUE of 1.05 under the test conditions (NESIC, 2025).	Demonstration projects can be used to verify reliability and energy performance before wider deployment. The KDDI demonstration reported a PUE of 1.05 and a 94% reduction in server-cooling energy compared with its conventional-cooling reference case. The result should not be interpreted as a 94% reduction in total facility electricity use.
10.	**Low-carbon grid as the foundation for scale**	**Finland**: is using a low-carbon electricity system, supported by nuclear and wind generation, as a foundation for data-centre expansion. DC Byte's Nordic data-centre assessment reports that approximately 95% of Finland's electricity is produced from carbon-neutral sources and emphasizes the alignment of energy, planning and public policy (DC Byte, 2025).	Reliable low-carbon electricity, infrastructure planning and policy coordination can support long-term data-centre investment. Finland's electricity mix and Nordic planning approach are presented as important foundations for development.

Chapter 3 Africa's Data Centre Ecosystem

This chapter examines the current state and growth prospects of Africa's data-centre ecosystem. It analyses market size, capacity distribution, and emerging investment trends, highlighting the increasing demand for digital infrastructure driven by expanding connectivity, cloud adoption, digital services, and artificial intelligence (AI). It also assesses existing gaps and constraints, particularly in relation to energy supply, digital infrastructure, and technical capacity.

3.1 Market Overview and Landscape

Africa's data-center market remains relatively small compared with other global regions but is experiencing significant growth, driven by cloud adoption, digital transformation, and increasing demand for locally hosted digital services. According to the Africa Data Centers Association, the continent had approximately 360 MW of operational data-center capacity in 2026, with an additional 238 MW under construction and 656 MW planned. Despite this expansion, Africa accounts for only 0.6 % of global data-center capacity, highlighting the substantial gap between its digital infrastructure and its population and economic potential (ADCA, 2026a). McKinsey projects that African data-center demand could increase from approximately 0.4 GW to 1.5–2.2 GW by 2030, requiring an estimated US$10–20 billion in new core-and-shell investment, excluding IT fit-out costs. The broader data-center value chain could generate a revenue pool of US$20–30 billion by 2030 (Jayaram & Bennici, 2025).

Data-center development remains geographically concentrated, with South Africa accounting for approximately two-thirds of Africa's third-party colocation capacity and hosting the majority of the continent's hyperscale cloud deployments. As of 2026, Africa had approximately 249 data centers, of which 61 were located in South Africa (24.5%), followed by Nigeria with 25 (10.0%) and Kenya with 19 (7.6%), meaning these three countries collectively hosted approximately 42.2% of the continent's facilities (Intelpoint, 2026). In terms of market value rather than facility count, South Africa accounted for approximately 40.76% of Africa's data center market in 2025 (Mordor Intelligence, 2025). Johannesburg has emerged as the principal hub for hyperscale facilities, cloud services, and financial-sector workloads, supported by established telecommunications infrastructure, electricity networks, enterprise demand, and international cloud providers. However, investment is gradually expanding into other markets, particularly Nigeria, Kenya, Egypt, and Morocco, where improving connectivity, digital services, and demand for local hosting are encouraging new developments (Matthews, 2026).

Nevertheless, growth remains uneven, reflecting differences in electricity reliability, connectivity, regulatory frameworks, investment conditions, and market readiness. The main drivers of market expansion include the increasing adoption of cloud computing, digital financial services, mobile money, e-commerce, digital-government platforms, and growing requirements for data sovereignty and local hosting. Emerging artificial intelligence (AI) and high-performance computing applications are also expected to increase demand for computing capacity, although

these workloads require substantially greater electricity supply, advanced cooling systems and specialized infrastructure. In addition, the brooder socioeconomic drivers includes: First, demographic expansion and rapid urbanization are enlarging the potential market for digital services, with Africa's population projected to approach 2.5 billion by 2050 (United Nations Department of Economic and Social Affairs [UN DESA], 2024); second, financial inclusion and digital financial services are increasing demand for secure transaction processing and data storage, with approximately 1.1 billion registered mobile money accounts in Sub-Saharan Africa in 2024 (GSMA, 2025); third, adult financial account ownership rose from 49% in 2021 to 58% in 2024 (World Bank, 2025b); and fourth, growing digital participation among young and urban populations is stimulating demand for online services, with internet usage reaching 50% among African youth aged 15–24 and 55% in urban areas in 2025 (International Telecommunication Union [ITU], 2026). While demand is increasing, planned capacity does not necessarily translate into immediate utilization, particularly in emerging markets where investment may precede customer demand (ADCA, 2026a; Jayaram & Bennici, 2025).

Africa offers significant opportunities for sustainable and technology-driven data center development. These opportunities are supported by the continent’s renewable-energy resources, growing demand for cloud and AI infrastructure, and rising private-sector interest. *First*, renewable-energy-powered data centers can support cleaner and more cost-effective operations, as Africa possesses approximately 60% of the world's best solar energy resources (IEA, 2024); *second,* expanding cloud computing and AI infrastructure creates investment opportunities in hyperscale, colocation, and AI-ready facilities, with approximately 40% of African corporations experimenting with generative AI (Kuyoro et al., 2025); and *third,* increasing investor interest enables infrastructure financing, public-private partnerships, and regional expansion, with 77.4% of surveyed participants planning major capital investments and 93.6% anticipating sector growth over the following 12 months (ADCA, 2025).

Connectivity infrastructure plays a critical role in determining the location and competitiveness of data centers. Major submarine cable systems, including 2Africa with approximately 180 terabits per second (Tbps) of design capacity, and Google's Equiano, with approximately 144 Tbps, significantly increasing potential international bandwidth serving African markets, are strengthening international bandwidth and improving connectivity between Africa and global digital markets (Nwankwo, 2025). Such investments enabled access to more than 200,000 km of submarine cable systems serving Africa (WIOCC, n.d.). However, access to connectivity infrastructure remains uneven, with only 21 sub-Saharan African countries having access to carrier-neutral data centers, signaling the continuing need for stronger domestic fiber networks, regional interconnection, and distributed data center development (Teraco Data Environments, 2026). Terrestrial fiber networks, cross-border connectivity, and Internet Exchange Points (IXPs) are important for reducing latency, improving network resilience, and enabling more internet traffic to remain within Africa (Matthews, 2026). However, connectivity gaps persist in landlocked

countries and secondary cities, where limited network redundancy and high connectivity costs can constrain data-center development.

Africa's data-center ecosystem includes international cloud providers such as Amazon Web Services, Microsoft Azure and Google Cloud, alongside colocation operators, telecommunications companies, regional infrastructure developers and institutional investors. Major market participants include Teraco/Digital Realty, Equinix, Africa Data Centers, and Raxio Group, among others. Ownership structures range from privately operated and telecom-owned facilities to government infrastructure, joint ventures and public-private partnerships. Business models include retail and wholesale colocation, hyperscale facilities, managed hosting, cloud infrastructure, and edge computing. These models allow organizations to access secure computing infrastructure without necessarily investing in dedicated facilities (Jayaram & Bennici, 2025; Matthews, 2026).

Overall, Africa's data-center market presents significant opportunities for investment and digital transformation, but its long-term development will depend on addressing infrastructure and market constraints. Reliable and affordable electricity, resilient connectivity, supportive regulations, access to financing, and sufficient customer demand will be essential to expanding capacity beyond established hubs. Coordinated investment in digital and energy infrastructure will therefore be critical to ensuring that data-center expansion supports sustainable economic development across the continent (ADCA, 2026a; Jayaram & Bennici, 2025).

3.2 Governance and Barriers

The growth of Africa's data-centre industry is closely linked to concerns about data governance and digital sovereignty. Building data centres within African countries helps governments and businesses keep data closer to where it is generated, but location alone does not guarantee full control over data. Real sovereignty also depends on factors such as who owns the infrastructure, how data is managed, cybersecurity protections, access controls, contractual arrangements, and the strength of data-protection regulations (African Union Commission [AUC], 2024a; Gelvanovska-Garcia et al., 2024). Although more than 40 African countries had adopted data-protection laws by 2026, these regulations do not always require data to remain within national borders. Instead, the trend reflects a growing emphasis on privacy, cybersecurity, and trusted regional hosting solutions (ADCA, 2026a; AUC, 2024a). The major barriers of data centers in Africa could be categorized into five: f*irst,* unreliable electricity supply remains a major barrier, ranking as the second-largest industry challenge with a severity score of 2.81 out of 6 (ADCA, 2025); *second,* fragmented regulatory frameworks create investment uncertainty, with 44 African countries having data protection laws but only 37 maintaining operational regulatory authorities (Centre for Intellectual Property and Information Technology Law [CIPIT], 2026); *third,* limited access to financing constrains infrastructure investment, with 52.4% of surveyed participants preferring private capital, compared with 26.2% favoring development finance institutions and 4.8% bank loans (ADCA, 2025); *fourth,* shortages of skilled professionals affect operational capacity, with 39% of operators reporting difficulties retaining skilled employees and 22.6% identifying insufficient specialized training (ADCA, 2025); and *fifth,* uneven market and infrastructure readiness continues

to constrain sector development, despite 80.6% of participants considering business conditions favorable (ADCA, 2025).

A major obstacle to expanding data-centre capacity across Africa is the availability of reliable infrastructure, particularly electricity and connectivity. Data centres consume large amounts of power and require stable electricity networks and effective backup systems. In many countries, unreliable power supply forces operators to rely on expensive diesel generators, increasing operating costs and reducing competitiveness (ITU & World Bank, 2023; Gelvanovska-Garcia et al., 2024). Strong digital connectivity is equally important because data centers deliver greater economic benefits when connected to fiber-optic networks, internet exchange points, telecommunications providers, cloud platforms, businesses, and public institutions (World Bank, 2021; Gelvanovska-Garcia et al., 2024). At the same time, broader challenges such as limited financing, foreign-exchange risks, regulatory hurdles, high construction costs, and a lack of guaranteed customers can delay or even prevent projects from moving forward (Jayaram & Bennici, 2025; ADCA, 2026a).

Beyond infrastructure investment, the long-term success of the sector depends on creating economic value within African countries. Data centers can generate sustainable employment opportunities in areas such as engineering, cybersecurity, cloud services, software development, equipment maintenance, and energy management, rather than only providing temporary construction jobs (ADCA & Oxford Business Group [OBG], 2024; International Telecommunication Union & World Bank, 2023). To achieve this, governments, educational institutions, and industry stakeholders need to invest in skills development through specialized training programs, apprenticeships, certifications, and partnerships with universities and technical colleges (Gelvanovska-Garcia et al., 2024). Without building local expertise and institutional capacity, the industry may continue to rely heavily on imported technologies and foreign specialists, limiting knowledge transfer and reducing the economic benefits retained within African economies (ADCA & OBG, 2024).

3.3 Outlook to 2030

Africa's data-centre market is expected to expand considerably by 2030 as businesses and governments make greater use of cloud services and digital technologies. However, growth is likely to remain uneven across countries. McKinsey's 2025 analysis projects that demand in five leading markets; Egypt, Kenya, Morocco, Nigeria, and South Africa could reach approximately 1.5–2.2 GW of IT load by 2030. These projections indicate significant potential, but their realisation will depend on demand, reliable infrastructure and access to financing (Jayaram & Bennici, 2025). Reliable and affordable electricity will be central to this expansion. ADCA's 2026 report summary identifies power availability as the industry's principal constraint, highlighting the importance of securing electricity supply early in project development. Africa's electricity generation capacity is expected to rise by over 50% by 2030 from the current 1,130 TWh to about 1,788 TWh, supported by renewable energy generation capacity and growth in regional grid infrastructure (Vanham, 2026).

The continent holds massive potential for renewable energy, including an estimated 10 terawatts (TW) of solar, 350 GW of hydropower, 110 GW of wind, and 15 GW of geothermal power which could be engaged with data center development in parallel as off-grid and mini-grid systems (Yeboua, 2026). Certain regional hubs could be established for power generation while geographically suitable areas in climate condition, water availability, and submarine connectivity could be used for data-centre development. This would require a regional cooperation framework between member states. Governments, utilities and data-centre operators will therefore need to coordinate investment in power generation, grid connections and digital infrastructure. Energy efficiency, water availability and exposure to climate risks should also inform decisions about where facilities are built and how they are operated (ADCA, 2026a; ITU & World Bank, 2023).

Regional cooperation could help extend access to data-centre services beyond established markets. Countries with smaller domestic markets may benefit from using regional hosting facilities connected through reliable cross-border fibre networks. The World Bank identifies the pooling of demand across countries as one way to achieve economies of scale and attract investment (Gelvanovska-Garcia et al., 2024). In Africa, this approach would require clear arrangements for cross-border data transfers, effective data protection and dependable connectivity. It would also support the African Union's ambition to develop a more integrated and trusted continental data ecosystem (AUC, 2024a). Investment will also need to match the needs of customers. Operators and investors should assess demand carefully and expand facilities as customer commitments grow.

Governments can support this process through clear regulations and well-planned procurement of digital services. Alongside infrastructure development, partnerships with universities and technical institutions can help build the skills needed to operate facilities and support the wider cloud-services ecosystem. These measures would help African economies retain more of the value associated with data-centre investment. The strategic priority to 2030 should be to expand usable, resilient and environmentally responsible computing capacity. Governments should align investment incentives with infrastructure availability and measurable public benefits; investors should assess customer commitments and operating risks before scaling projects; and operators should plan for changing workload and cooling requirements. Progress should be assessed through commissioned capacity, customer utilization, service reliability, resource use, and local skills development. These are proposed assessment criteria, intended to move the discussion beyond the value of announced investments.

Chapter 4 Energy Requirements and Infrastructure Needs

This chapter examines the energy implications of Africa's expanding data-centre ecosystem, focusing on current and projected electricity demand and the capacity of existing power systems to accommodate future growth. It provides the study's principal quantitative assessment of data-centre energy requirements, power-system readiness, and the infrastructure investments needed to support sectoral expansion. The chapter also evaluates sustainable energy supply options, including renewable energy integration, energy storage, energy-efficiency improvements, and innovative cooling technologies, to identify pathways for strengthening energy security, improving operational resilience, and reducing the environmental footprint of data-centre development across Africa.

4.1 Data-Centre Energy Demand and Load Requirements

4.1.1 Electricity requirements by data-centre scale and type

Electricity requirements vary with facility scale, operating load, equipment type, and workload. *Edge and small enterprise* sites generally create modest, dispersed loads, while *colocation facilities* aggregate demand from multiple customers. *Cloud and hyperscale facilities* can require substantial, concentrated grid connections and often expand in phases. *Artificial intelligence (AI) and high-performance computing (HPC)* workloads can increase rack-level power density and cooling requirements across these facility categories. These categories overlap: AI workloads can run within a colocation or hyperscale site. Facility size should therefore be assessed from the commissioned IT design load, contractual maximum demand and measured utilization rather than labels alone (International Energy Agency [IEA], 2025b, 2026c). **Table III** below shows the typical electricity demand of data centres based on facility type and the primary planning issues that need to be addressed when venturing to development.

Table III. Data-center types, electricity demand, and power-system implications.

Facility type	Typical Tier Classification	Typical load character	Primary planning issue
Edge / enterprise	Tier 2/3	**1-10 MW**; Smaller, dispersed loads; often modest but site-specific; **Ave PUE 1.5-2.0**	Distribution reliability and modular UPS/backup.
Colocation	Tier 3/4	**10-50 MW**; Expandable tenant-driven blocks; variable occupancy; **Ave PUE 1.3-1.5**	Phased firm capacity, contracts and dual feeds.
Hyperscale / cloud	Tier 3/4 Base + Software Mesh	**100-1000+ MW**; Large campus loads; often staged across multiple buildings. **Ave PUE 1.1-1.4**	Transmission access, substation capacity and resource adequacy.
AI / HPC workloads	Tier 3/4 Base + Software Mesh	Concentrated, high-density racks and rapidly varying workloads.	Heat rejection, short-term power quality and storage.

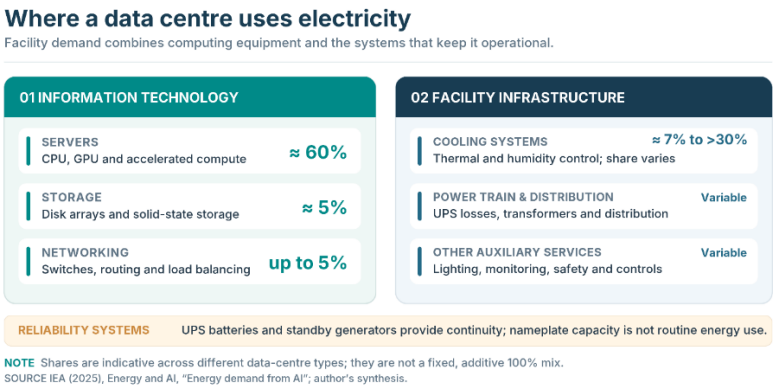
Source/notes: *Analytical classification based on IEA (2025a; 2026b). MW boundaries are based on data from DC Atlas (n.d.) and Operand (n.d.). Tier classifications based on Uptime Institute's 4-Tier Standard, which rates facilities based on reliability, uptime, redundancy, and maintenance capability to support a given IT load (Uptime Institute, n.d.). Tier I: A basic data center with a single path for power and cooling and no redundant components, making it the most susceptible to downtime. Tier II: A data center with redundant capacity components (such as backup power and cooling equipment) that provides improved reliability over Tier I. Tier*

III: A concurrently maintainable data center that allows planned maintenance on power and cooling systems without shutting down operations. Tier IV: A fault-tolerant data center with multiple independent and redundant systems that can withstand unplanned failures without impacting operations.

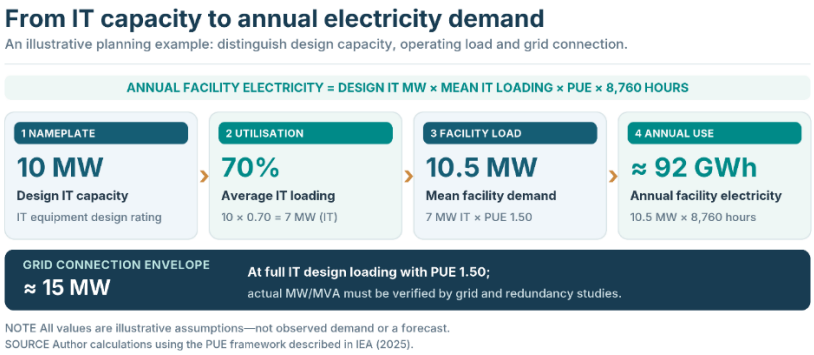
Table III also shows the average Power Usage Effectiveness (PUE) which is a standard industry measure of power utilization in data centers which quantifies the total power consumption of each facility compared to power used for purely computing purposes. A PUE of 1.5, for instance, means that each 1 MWh delivered to servers, storage and networking requires additional 0.5 MWh for cooling, facility lighting, and other infrastructure. However, PUE is not an indicator of useful computing output, reliability, carbon intensity or water performance. The 2025 Uptime Institute survey reported a global mean annual PUE of 1.54 and a combined Middle East–Africa figure of 1.68 indicating there's considerable room for improvement in power utilization of data centers in Africa (Donnellan & Weinschenk, 2025). PUE is not fixed by facility type; it also depends on climate, load factor, design, and measurement practice. For power-system planning, nominal IT capacity must therefore be translated into peak facility demand and annual electricity use using transparent assumptions.

4.1.2 Sources of facility electricity demand

In simple terms, data centers are facilities where most of the world's compute needs are taken care of. The facilities house individual components such as storage equipment, networking systems, servers, and related auxiliary apparatuses that are usually installed in racks and assembled into rows. Each component has different functions and electrical demand. Apart from the IT infrastructure (servers, storage and networks), data centers require electricity for facility lighting, office equipment, and other on-site staff electricity needs. The other main component of data centers is the cooling and environmental control system that keep the temperature and humidity of the facility at optimal conditions for the servers, storage systems, and networking equipment to function properly. Electricity consumption of cooling and environmental control systems ranges from 7% usage for highly efficient hyperscale facilities up to 30% for less-efficient enterprise data centers (IEA, 2025b).



Grid planners require three separate quantities: (i) installed IT design capacity (MW); (ii) expected average facility demand (MW); and (iii) peak import / contracted connection capacity (MW or MVA). The latter may exceed average demand markedly, especially for AI clusters and redundancy requirements. A 10 MW IT-design facility operating at a mean 70 % IT loading and PUE 1.50 would consume about 92 GWh in one year, but planners may still have to size its firm interface near 15 MW at fully occupied IT load, before engineering margins.



4.1.3 Current and projected African electricity demand

The development of data centers in Africa has been gaining momentum in recent years although there is still a long way to go to cover demand and be competitive in the global data center markets. The continent has an installed capacity of 360 MW alongside 238 MW under construction. An additional 656 MW is planned to be installed by 2030 — a combined development inventory of 1,254 MW (approximately 1.2 GW) which will push the continent's data center market share from about $3.49 billion in 2024 to nearly $6.81 billion of projected growth by 2030, at a compound annual growth rate of roughly 11.8% (ADCA, 2026a; Research and Markets, 2025).

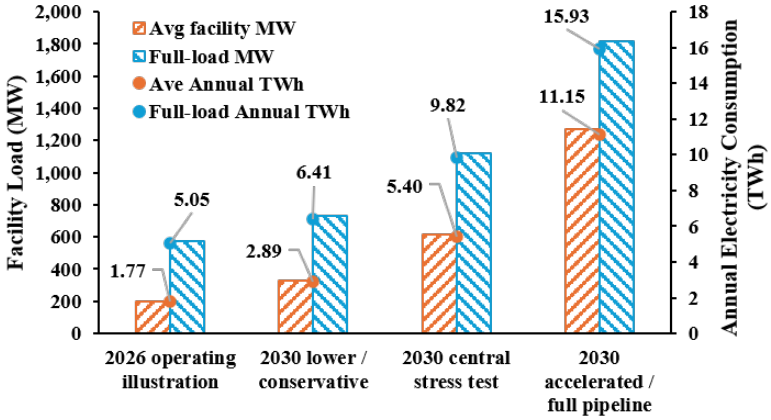
A sensitivity analysis based on different loading factors and PUE levels gives a broader understanding of energy demand from data centers rather than relying on a single forecast number. A useful starting equation is:

$$E_{\text{annual}} = \frac{C_{\text{IT}} \times U \times PUE \times 8760}{10^6}$$

Where E_{annual}= annual electricity consumption (TWh), C_{IT}= installed IT capacity (MW), U= average IT electrical loading factor, PUE= power usage effectiveness and 8,760 = hours per year.

According to the report by Africa Data Centers Association (ADCA) (2024), the utilization of installed data center capacity ranges from 33% to 74% showing a noticeable capacity gap. The plot shown in **Figure III** shows estimated indicative electricity demand for four different utilization and PUE factors that are applicable to Africa.

Figure III Indicative electricity demand under four stated utilization and commissioning cases.



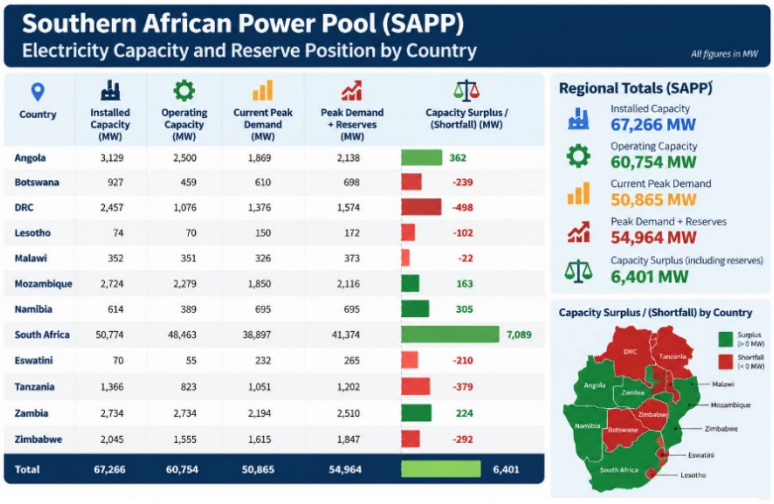
***Source/notes**: Commissioned shares of the 238 MW construction / 656 MW planned stock: conservative 40% / 5%; central 80% / 30%; accelerated 100% / 100%. Operational capacity is held at 360 MW across 2030 cases to avoid double counting. PUE and loading factors are analytical assumptions with assumed loading factors of 35%, 45%, 55%, 70% and PUE of 1.6, 1.5, 1.5, and 1.45 for the four cases, respectively. Full-IT-load MW = commissioned IT MW × assumed PUE; Avg-IT-load facility MW = Full-IT-load facility MW × Loading factor. The assumed PUE and loading factors are based on reports by Africa Data Centers Association (ADCA, 2026b).*

Based on the 2026 Electricity Mid-Year update of IEA, continental electricity consumption of 843 TWh would imply that accelerated full pipeline by 2030 would require nearly 2% of the continental electricity consumption (IEA, 2026b). The IEA's 2025 assessment placed African data-center electricity demand below 1 kWh per person in 2024 and projected under 2 kWh per person in 2030, reflecting a much more restrained regional trajectory (IEA, 2025b). The central and accelerated Africa scenarios here should therefore be understood as upside infrastructure-commissioning stress tests, not as substitutes for the IEA regional outlook. Differences in study year, sample coverage, utilization, facility definitions and realization of proposed projects prevent direct reconciliation.

4.2 Power-System Readiness and Grid Implications

4.2.1 Generation, adequacy, and electricity availability

Across Africa, generation adequacy is uneven and, in many national power systems, current dependable capacity is insufficient to absorb large, continuous data-centre loads without additional investment. Electrification has barely kept pace with population growth, almost 600 million Africans still lack electricity, and many utilities have limited financial capacity to expand supply (IEA, 2025e). Each proposed connection should therefore be assessed against available capacity at peak demand, reserve margins, planned generation additions, and competing household and productive-use needs. Where these tests reveal shortfalls, grid-connected data-centre development should be phased or matched with additional firm supply so that it supports, rather than undermines, reliability and



***Source**: Southern African Power Pool.*

Africa's electricity-access objectives (Balabanyan et al., 2021). Moreover, a country's annual electricity production or national installed generation capacity cannot alone establish readiness for a continuous 24-hour data-center load. Relevant metrics are firm available capacity in constrained periods, reserves, seasonal demand, and the ability to serve the actual connection point. Illustrate generation adequacy and reserve margin analysis is demonstrated for Southern Africa region.

4.2.2 Grid reliability, transmission and distribution

Grid readiness is constrained by frequent scheduled and unscheduled outages, weak voltage quality, limited transmission capacity, and unreliable distribution networks. African systems, excluding North Africa, lost about 13% of electricity output through transmission and distribution in 2023, with substantially higher losses in several countries (World Bank, n.d.). For data centres, national generation availability is therefore insufficient evidence of readiness: utilities must verify capacity at the relevant substation and corridor, connection timelines, power quality, and resilience to a single network failure. Large facilities generally require diverse feeders or independent supply paths, supported by uninterruptible power supplies and backup generation, while connection approval should be conditional on any reinforcements needed to avoid worsening reliability for existing consumers (SEforALL, 2025; Timilsina, 2025). The decisive bottlenecks can be substation capacity, ageing feeders, long transmission routes or poor power quality rather than shortages of nationally installed generation. Developers should obtain independently audited outage statistics (SAIDI/SAIFI or equivalent), local voltage and frequency performance, feeder loading, restoration times and committed grid-upgrade schedules. An IEA assessment estimated that grid limitations could delay around 20% of planned global data-center capacity by 2030, reinforcing the need for location-based rather than country-average screening (IEA, 2025b).

4.2.3 Electricity affordability and cost competitiveness

African data-centre competitiveness depends on the total cost of reliable electricity, not the published industrial or commercial tariff alone. Operators must also absorb connection and demand charges, power-conditioning equipment, batteries, maintenance, and diesel or gas backup during outages. These reliability-related costs can erase an apparent tariff advantage. Tariffs should therefore be transparent, with dedicated network upgrades financed by the connecting customer rather than shifted to households or existing firms. Locations offering reliable grid supply and predictable pricing will be more competitive than nominally low-tariff markets that require extensive self-generation (Kojima & Trimble, 2016; IEA, 2025e). Data centres are large, concentrated loads that can develop faster than generation and network infrastructure. Utilities should validate project pipelines, model phased demand at the proposed node, assess cumulative impacts on substations and transmission corridors, and identify required reinforcements before granting capacity. Milestone-based connection agreements and financial security can limit speculative reservations and stranded investment, while regional interconnectors and power pools can widen access to diversified supply. Planning should ensure that data-centre growth strengthens grid investment without compromising reliability, affordability, or electricity-access objectives (SEforALL, 2025).

4.2.4 Grid interconnection and implications for system planning

Electricity ministries, regulators and utilities should establish a shared, geocoded register of proposed large digital loads: IT MW, maximum import MW/MVA, preferred energization date, phased ramp-up, backup technology, demand-response potential, and evidence of financing. Large-load connection agreements can phase capacity rights alongside substations and new generation, require financial security for speculative reservations and define who pays for shared network reinforcements. Plans should assess alternative sites near surplus firm generation or existing transmission corridors; land availability and submarine cable proximity are not sufficient criteria. Captive power generation models for data centers offer alternative pathways that could avoid grid-based constraints.

4.3 Power-Supply Models, Resilience and System Integration

Global electricity generation to supply data- centers is projected to grow from 460 TWh in 2024 to over 1 000 TWh in 2030 and 1300 TWh in 2035 in the baseline, highlighting the importance of integrating digital infrastructure planning with electricity-system development (IEA, 2025b). The market for data centers in Africa is entering a phase of accelerated growth, with demand for capacity expected to rise from about 0.4 gigawatts (GW) today to 1.5 to 2.2 GW by 2030. The opportunity is substantial, requiring $10 billion to $20 billion in new investment and unlocking an estimated revenue pool of $20 billion to $30 billion across the value chain by 2030 (Jayaram et al., 2025). Power supply models, therefore, become crucial. In general, data centres in Africa could be powered via at least four supply models: *grid-connected supply* from national utilities, *renewable energy integrated with grid electricity* to reduce costs and emissions, *dedicated or captive generation* to improve supply control, and *hybrid systems* combining grid power, renewables, battery storage, and backup generators to enhance reliability and resilience. *Regional power supply* could also be envisaged.

Beyond individual facilities, data-centre expansion has broader implications for national and regional electricity systems, including generation capacity, transmission infrastructure, grid reliability and electricity affordability. Concentrated demand from data-centre clusters may require substantial grid investments and could compete with household electrification and industrial electricity needs, particularly in energy-constrained African countries (IEA, 2025b). However, data centres could also serve as anchor customers for new renewable generation, energy storage and shared transmission infrastructure. Regional power pools and cross-border electricity trade could further enable data-centre hubs to access renewable energy across national boundaries. Governments should therefore integrate projected data-centre demand into national and regional energy planning, ensuring that investments strengthen electricity infrastructure, expand access and support broader economic development (World Bank, 2012).

4.3.1 Grid-connected renewable-energy procurement

Grid-connected renewable energy systems enable the integration of renewable energy allowing for sustainable and reliable power supply (SolaX Power, 2025). Utility supply remains the only readily

scalable primary source for most data centers typically operating with a power demand exceeding 100 MW, and some new campuses are planned to scale to the gigawatt (GW) level (Chen et al., 2026). Power Purchase Agreements (PPAs) can support new utility-scale renewables generation. The IEA (2022) also emphasizes that wheeling charges and energy-banking arrangements should reflect the wider costs and benefits imposed on the electricity system. International Renewable Energy Agency (IRENA, 2025) reports that the global weighted-average levelized cost of electricity for newly commissioned utility-scale solar PV and onshore wind was USD 43/MWh and USD 34/MWh, respectively, in 2024. These figures provide energy generation-cost benchmarks for data centers.

Table IV Global weighted average total installed cost, capacity factor and LCOE trends by technology, 2010 and 2024.

	Total installed costs (2024 USD/kW)			Capacity factor (%)			Levelised cost of electricity (2024 USD/kWh)		
	2010	2024	Percent change	2010	2023	Percent change	2010	2024	Percent change
Bioenergy	3 082	3 242	5%	72	73	1%	0.086	0.087	1%
Geothermal	3 083	4 015	30%	87	88	1%	0.055	0.060	9%
Hydropower	1 494	2 267	52%	44	48	9%	0.044	0.057	30%
Solar PV	5 283	691	-87%	15	17	13%	0.417	0.043	-90%
CSP	10 703	3 677	-66%	30	41	37%	0.402	0.092	-77%
Onshore wind	2 324	1 041	-55%	27	34	26%	0.113	0.034	-70%
Offshore wind	5 518	2 852	-48%	38	42	11%	0.208	0.079	-62%

***Source**: International Renewable Energy Agency (IRENA) -Datafile-RenPwrGenCosts-in-2024*

4.3.2 Captive, off-grid and mini-grid-based data centres

An important distinction should be made between hyperscale facilities and smaller distributed/edge facilities. Mini-grid solutions will not be equally suitable across scales. The World Bank estimates mini grids could serve 500 million people by 2030 but would require about USD 220 billion of investment to build around 210,000 mini grids (World Bank, 2019). Over the last decade, mini grid costs have declined significantly, while the quality of service has increased. The per kWh cost of mini grid electricity is expected to decrease by two thirds by 2030 (World Bank, 2019). Significantly more mini grids will need to be deployed in the top 20 electricity access deficit countries from 10-50 mini grids currently deployed each year per country to over 1,600 (World Bank, 2019). A study by Rollinson et al. (2025) assessed the techno-economic feasibility of off-grid hyperscale data centres using hybrid wind, solar, battery storage and gas backup systems across five European locations. The study estimated electricity costs of GBP 70–102/MWh and emissions of 0.021–0.074 t CO_2 eq/MWh, demonstrating the potential of hybrid power configurations under the modelled conditions. **Table V** give comparative evaluation of different energy sources that can be used to power data centres.

Table V Comparative Evaluations of different energy sources at Glance.

Energy Source	Function	Benefits	Challenges
Captive Renewable Generation	On-site, dedicated clean power production	Low operational costs; carbon reduction.	Highly intermittent; weather dependent.
Hybrid Generation	Multi-source energy blending (e.g., PV + Battery + Diesel).	Balances grid stability with clean energy.	Complex control software requirements.
Data centre microgrids	Active localized grid offering continuous island mode	Bypasses long utility delays; 24/7 reliability.	Very high capital investment; complex load profiles.
Role of Mini-Grids for Smaller/Edge Infrastructure	Small, isolated distribution networks for remote nodes.	Cost-effective rural/edge power expansion.	Regulatory hurdles; long-term financial risks.

4.3.3 Storage, backup power and resilience

Reliable data-centre operations depend on UPS systems, batteries, and backup generators to maintain power during outages. Battery storage can also integrate renewables, reduce peak demand, and shift electricity use to periods of higher renewable availability. Global average installed costs for utility-scale battery storage fell to USD 192/kWh in 2024, 93% below 2010 levels. However, system sizing must reflect power demand, backup duration, and operating conditions. Uptime Institute (2024) identifies power problems as a recurring leading cause of serious data-centre outages, reinforcing the need for redundancy, maintenance and robust backup arrangements (Donnellan & Lawrence, 2024). Hybrid systems combining grid supply, renewables, batteries and dispatchable backup can therefore improve resilience while reducing reliance on diesel generation (IRENA, 2025). The World Bank's dataset reports double-digit transmission and distribution losses across much of Sub-Saharan Africa, supporting grid-plus-storage-plus-dispatchable-backup designs rather than reliance on a single supply path (World Bank, n.d.).

4.3.4 Regional power pools and cross-border electricity supply

Regional electricity markets could improve supply diversity and enable data-centre hubs to access renewable resources beyond national borders. In East Africa, the Ethiopia–Kenya Eastern Electricity Highway was designed as a 2,000 MW bidirectional transmission interconnector, creating infrastructure for cross-border electricity exchange (World Bank, 2012). The Southern Africa Power Pool similarly has improved national electricity supply by enabling cross-border electricity trading, coordinating power-system operations, and facilitating the sharing of available generation resources among member countries. However, the benefits available to data centres depend on transmission availability, regional market rules, electricity contracts and the reliability of participating power systems. Cross-border connections should therefore be viewed as an opportunity to diversify supply rather than a guarantee of uninterrupted electricity (World Bank, 2012).

4.3.5 Energy additionality and system integration

Energy additionality should mean that data-centre procurement enables new clean generation and/or firming investment that would not otherwise occur, without undermining general electricity-access plans. Impact claims should document project commissioning dates, financing, geographic deliverability, hourly supply profiles and treatment of renewable attributes. Large clients can anchor bankable generation or network investments, provided costs and benefits are allocated transparently and surplus capacity is shared where practicable. The appropriate policy objective is not data-centre energy autarky, but demonstrable net improvement in system reliability, renewable supply and affordability. For instance, the World Bank (2026b) report showed West African interconnections enabled Guinea-Bissau and The Gambia to import lower-cost hydropower, helping reduce generation costs and improve utilities' finances (World Bank, 2026b). For a future data-centre hub, a viable replication would require contracted deliverability, defined wheeling charges, congestion rights and local grid upgrades.

Case-study 1: Ireland's 2025 connection policy — making additional renewable supply measurable

Ireland's CRU decided in December 2025 that newly connecting data centres must meet at least 80% of annual electricity demand using additional renewable projects in the Republic of Ireland. The policy excludes already supported renewable generation from counting toward this requirement and allows a six-year transition for associated projects to become operational. It also links new demand to onsite or nearby generation/storage capacity aligned with maximum requested import demand. African regulators could define "additional renewable energy" as generation demonstrably built or financed because of new demand and distinguish it from pre-existing hydropower allocations or unbundled certificates. Contract review should capture incremental generation MW, expected hourly output, wheeling rights, grid investment, resource adequacy and affordable supply for surrounding consumers.

***Source**: Commission for Regulation of Utilities (Ireland) (2025). https://www.cru.ie/about-us/news/the-cru-publishes-its-decision-on-new-electricity-connection-policy-for-data-centres/*

Case-study 2: Teraco, South Africa— African best practice

Teraco's 120 MW Free State solar plant is expected to generate more than 354 GWh/year and wheel electricity through Eskom's network to its data centres. That output averages 40.4 MW across a year and equals about 40% of a continuously loaded 100 MW campus' annual requirement. The project demonstrates additionality through a new named generator and defined wheeling route, but solar variability means grid balancing, storage and backup remain necessary.

***Source**: Teraco Data Environments. (n.d.). Teraco Data Environments. https://www.teraco.co.za/*

4.3.6 Small Modular Reactors (SMR) as an Emerging Low-Carbon Energy Supply Option

Small modular reactors (SMRs) are an emerging nuclear-energy technology capable of generating up to 300 MW of electricity per unit, offering a potential source of reliable, low-carbon power for energy-intensive infrastructure, including data centres (Liou, 2023). Their modular design could facilitate incremental capacity expansion, while their ability to provide continuous electricity generation could complement intermittent renewable-energy sources. Growing electricity demand from artificial intelligence, cloud computing and hyperscale facilities has increased interest in nuclear-powered data centres, with SMRs emerging as a potential longer-term energy-supply option, particularly beyond 2030 (IEA, 2025b). For Africa, SMRs could support large data-centre

clusters and industrial hubs while contributing to national electricity-generation capacity and energy security.

However, SMR deployment faces significant challenges, including high capital costs, uncertain commercial competitiveness, regulatory and institutional readiness, nuclear safety and security, radioactive-waste management, fuel supply and cooling-water requirements (NEA, 2026). Their application in Africa should therefore be considered within broader national energy-development strategies rather than as dedicated power solutions for individual data centres. Countries should assess their technical and economic feasibility against other low-carbon alternatives, including geothermal, hydropower, solar, wind and energy storage, while ensuring that potential investments support wider electricity access, environmental sustainability and long-term economic development.

4.4 Energy Efficiency, Cooling and Resource Requirements

4.4.1 Energy efficiency and facility performance

Sustainable data-center design requires both low infrastructure overhead and efficient computing. Measures include server virtualization and consolidation, high utilization, energy-proportional IT hardware, efficient UPS and transformers, containment of hot/cold aisles, variable-speed fans and pumps, and thermal-control optimization (Van Geet & Sickinger, 2024). PUE should be reported as measured annual site performance with boundary conditions; future disclosures should also include IT energy, renewable sourcing quality, grid carbon intensity, water use and useful work performed. At identical IT utilization, improving PUE from 1.60 to 1.40 lowers facility electricity by 12.5%. However, an improved PUE by itself does not ensure lower absolute energy consumption when compute demand rises.

4.4.2 Cooling requirements by scale and technology

Conventional server rooms typically use air cooling, while high-density AI racks increasingly require direct-to-chip liquid or hybrid cooling. Evaporative cooling can reduce electricity use but consumes water, whereas immersion cooling presents equipment-compatibility and maintenance challenges. Technology selection should consider rack density, climate, water availability, maintenance capacity, and total cost. **Table VI** guides cooling technology selection according to environmental conditions, resource trade-offs, and data-centre type.

Table VI. Indicative cooling technology choices and resource trade-offs.

System	Potential strength	Principal constraint
Air / mechanical cooling	Mature, maintainable; well suited to lower-density racks.	Higher fan/chiller burden in hot conditions.
Evaporative / adiabatic	Potential electricity savings when climatic conditions permit.	Consumptive water use, water treatment and local stress.
Direct-to-chip liquid	Efficient heat capture at high rack densities.	CDU complexity, leak controls; final heat rejection still needed.
Immersion cooling	Possible high-density thermal management.	Fluid handling, hardware compatibility and specialist servicing.

4.4.3 African climatic conditions and cooling implications

Africa cannot adopt a single cooling template. Cooler high-altitude zones may have opportunities for economizers and dry cooling; hot, humid coastal locations present different constraints from hot, arid inland areas. Cooling design should consider hourly ambient dry-bulb and wet-bulb temperatures, seasonal humidity, particulate exposure, future climate extremes, altitude, heat-rejection capacity and water-treatment reliability. ADCA's 2026 climate-focused PUE white paper correctly highlights the need to assess PUE alongside water and environmental indicators rather than transferring global benchmarks without local context (ADCA, 2026b).

4.4.4 Water requirements and resource efficiency

Water-usage effectiveness (WUE) is annual site water consumption in liters divided by annual IT-equipment electricity in kWh; it measures direct onsite water use, not all water embodied in electricity generation (U.S. Department of Energy, n.d.-a; The Green Grid, 2011).

Case-study 3: Quincy, Washington — municipal–data-center water reuse partnership

The U.S. Environmental Protection Agency documents the City of Quincy–Microsoft water reuse utility, operational since 2021. The facility treats and recirculates Microsoft data-center cooling water; the EPA reports annual potable-water demand offset of about 138 million U.S. gallons (522 million liters) and a project cost of US$31 million. The case combines data-center needs, industrial wastewater treatment, mineral control and municipal water protection. For water-stressed African cities, screen reclaimed municipal or industrial effluent before approving large evaporative-cooling demand on drinking-water networks. Assess water quality, treatment, pipeline distance, wastewater discharge permits, brine disposal, public-health safeguards and long-term operator–municipality agreements. A water-reuse project can also require finance and technical assistance for the local utility. Water recycling reduces freshwater reliance but does not eliminate evaporation, make-up water or brine management. The EPA figures apply to Quincy; neither its cost nor water savings should be directly scaled by African data-center MW.

***Source**: United States Environmental Protection Agency (2023). Water reuse case study: Quincy, Washington. https://www.epa.gov/waterreuse/water-reuse-case-study-quincy-washington*

For illustration, 10 MW of IT capacity operated at 70% average IT loading uses 61.3 million kWh of IT electricity per year; at hypothetical site WUE values of 0.2 and 1.0 L/kWh, direct water requirements are 12.3 and 61.3 million liters/year, respectively, posing enormous strain on water resource. Site screening must take account of competing household and agricultural uses, drought, wastewater treatment and catchment-level baseline stress, using data such as WRI's Aqueduct tool (Kuzma et al., 2023).

4.4.5 Non-water or low-water cooling technologies

Dry coolers and closed-loop liquid systems can limit direct consumptive water use but may raise electricity demand or capital costs under extreme heat. Evaporative systems can reduce electricity at the cost of water; use of reclaimed water may mitigate freshwater pressure but adds treatment and operational requirements. Procurement should therefore compare whole-system PUE, WUE, heat rejection at extreme design temperatures, operational risks and, where possible, the indirect water footprint of the supply mix. Where both water stress and electricity scarcity are acute, a multi-criteria appraisal is more defensible than imposing a single blanket technology standard.

Case-study 4: Cape Town and Microsoft — two pathways toward low operational cooling-water use

Teraco reports that its completed CT2 expansion in water-stressed Cape Town uses a closed-loop cooling design with free-air cooling and zero water used during the cooling process. Microsoft separately announced a next-generation, closed-loop chip-cooling design intended to require no evaporated cooling water; in its December 2024 account, pilot sites were planned for 2026 and wider site openings from late 2027. Together, the examples distinguish an operator-reported operating African design from an announced wider rollout. For dry or water-scarce African locations, treat zero-evaporation cooling as an option to evaluate rather than a universal minimum standard. Procure designs against local wet-bulb temperatures, seasonal electricity demand, planned rack densities, water-consumption measurement and total life-cycle costs. Incorporate climate stress tests as temperatures rise. Microsoft explicitly cautions that replacing evaporative heat rejection can increase electrical PUE, with design innovations partially offsetting that penalty. Neither "closed-loop" nor "zero cooling-water consumption" means a facility uses zero water overall.

***Sources**: **Teraco** (2025). Teraco completes CT2 data centre expansion, increasing Cape Town's hyperscale capacity to 50 MW.*
***Microsoft** (2024). Sustainable by design: Next-generation datacenters consume zero water for cooling.*

4.5 Data-Centre Energy Readiness and Priority Infrastructure Needs

4.5.1 Data-Centre Energy Readiness Assessment Framework

A practical country readiness assessment should begin with a transparent and explicit site-level feasibility gate. Each criterion could be rated 0–3 (no verified readiness; major constraints; partial readiness; verified readiness) only after independent datasets and operator evidence are available. Equal weighting can be used for initial diagnostic comparisons but is not an evidence-based country ranking until methodology, thresholds, time periods and missing-data treatment have been validated. **Table VII** gives a six-dimension score card where core readiness indicators are summarized with possible evidence specifications.

Table VII Suggested readiness scorecard and minimum evidence.

Dimension	Core indicators to collect	Possible evidence holders
Availability	Firm MW available at the node; reserve margin; peak-season adequacy.	Utility generation plans; regulator; system operator.
Reliability	SAIDI/SAIFI, outage hours, voltage/frequency events, restoration.	Distribution utility; operator; independent audits.
Affordability	Delivered USD/kWh including demand, network and backup costs.	Tariff schedules; PPAs; operator accounts.
Clean-energy access	New deliverable clean MW/MWh, hourly matching, grid emissions.	Renewables agencies; generators; grid operators.
Grid infrastructure	Transformer/substation headroom, N-1, queue and connection time.	Transmission and distribution planners.
Resource suitability	Hourly ambient climate, basin water stress, hazard exposure.	Meteorological and water agencies; WRI Aqueduct.

***Source/notes**: Proposed study framework; indicators and scoring rubric are not yet populated with verified country observations. SAIDI/SAIFI = system average interruption duration/frequency indices; N-1 = capacity to withstand one major equipment outage.*

4.5.2 Priority infrastructure gaps and country typologies

The typologies specified in **Table VIII** are diagnostic pathways rather than labels assigned to individual states. National averages may conceal strong differences between metropolitan corridors and more remote locations; each investment decision therefore needs site-specific appraisal.

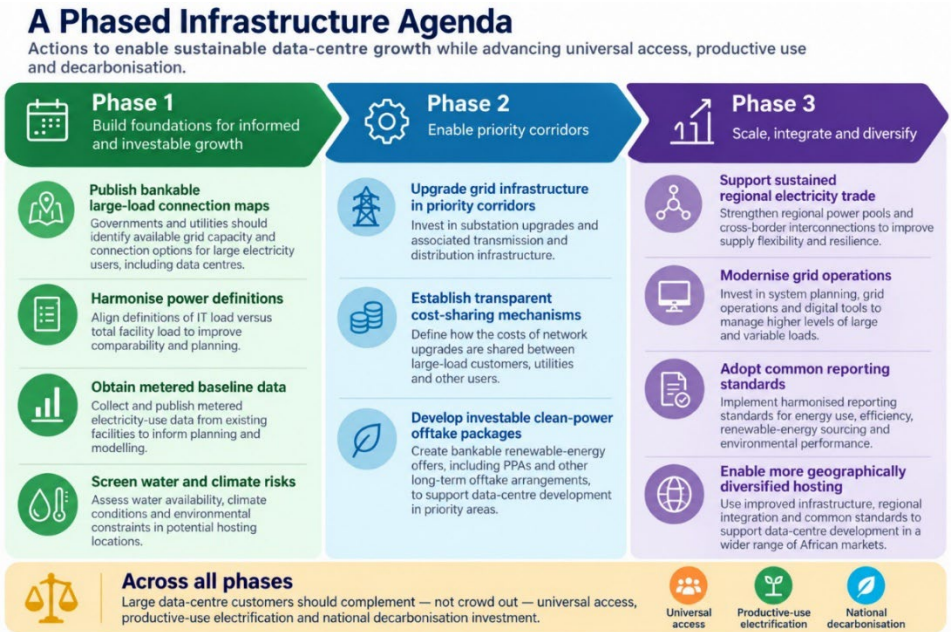
Table VIII Energy-readiness typologies and indicative investment priorities.

Market type	Typical binding constraint	Priority pathway
Established digital hub	Congested grid nodes despite strong connectivity and demand.	Add substations/lines; staged firm capacity; additional PPAs.
Emerging hub	Unreliable supply and limited bankable expansion.	Grid strengthening; resilience systems; credible tariff/offtake reform.
Renewable-resource opportunity	Clean resource exists but weak interconnection or demand scale.	Transmission and regional trade; firmed clean supply; anchor off-takers.
Small / landlocked market	Limited economies of scale and constrained network redundancy.	Modular edge hosting, shared regional facilities and interconnectors.

***Source/notes**: Categories are non-exclusive and require evidence-based country/site assignment.*

Governments should adopt a phased infrastructure strategy that aligns data-centre growth with universal electricity access, productive-use electrification, and decarbonisation. **Figure IV** presents a three-phased infrastructure development agenda. Initially, governments and utilities should publish grid-capacity and connection-readiness maps, standardise power-demand reporting, establish metered baselines, and assess water and climate risks. Next, they should prioritise grid upgrades, transparent connection-cost allocation, and bankable clean-energy procurement frameworks. Over the longer term, they should strengthen regional electricity trade, modernise grid operations, and harmonise reporting standards. Across all phases, policy and investment decisions should ensure that data-centre expansion does not undermine electricity access, affordability, or national decarbonisation commitments.

Figure IV Phased infrastructure development agenda.



Chapter 5 Policy, Regulatory and Investment Landscape

Data-centre investment can support new electricity supply and network capacity where the rules allow private capital and the contracts allocate costs clearly. This chapter examines the policy, regulatory, and investment environment shaping the development of data centres in Africa. It reviews national and regional frameworks related to digital infrastructure, energy, data governance, and investment, and assesses their effectiveness in enabling sustainable growth of the sector.

5.1 Policy and regulatory considerations to advance energy for data centers

5.1.1 Private investment in the grid system

Electricity and public–private partnership rules should provide a route for private parties to finance dedicated connections, substations and shared network reinforcement. Larger transmission projects may require a regulated concession. Before an investor commits capital, the regulator should settle asset ownership, network access, permitted revenue, performance standards and handback. Connection capacity should be reserved in phases against credible commissioning dates. Where a developer pays for works later used by others, the rules should provide for a fair contribution from subsequent users and prevent the same cost being recovered twice.

In practice, several models are available, and national rules should say which are permitted and on what terms:

- **Customer-funded dedicated connection.** The data centre pays for the connection assets that serve only its site. Ownership may remain with the customer or transfer to the utility on completion, with operation and maintenance obligations defined.
- **Customer-built, utility-owned works.** The developer builds shared reinforcement to the utility's standards and transfers it at commissioning. In return, it receives a connection right, a credit against future network charges or a refund from later users.
- **Independent transmission concessions.** A private company finances, builds and operates a transmission line or substation under a regulated revenue or availability payment and transfers it at the end of the term. These models suit larger, shared assets.
- **Contributions from later users.** Where a first developer funds capacity that later customers use, a published formula should require later users to reimburse a share, for a defined period, so that the first mover is not penalized and nobody pays twice.

Policy actions:

- Amend electricity and PPP legislation to authorize customer-funded and independent network investment, with ownership, access, revenue and handback rules approved by the regulator.
- Publish a contribution and reimbursement methodology for shared reinforcement.
- Replace first-come, first-served connection queues with milestone-based queues that require financial security and release capacity that is not used within a defined period.

5.1.2 Regulatory barriers to captive power investment

Countries should publish one clear approval route for facilities that generate electricity for their own use. The route should include generation owned by a third party under a lease or on-site supply contract. Requirements for own use should be proportionate to the size of the system and the effect on the grid, while sales to other customers should be assessed under the applicable supply rules. The route should cover storage, imports during shortfalls, safe operation during outages, export of surplus electricity and reconnection to the grid. Wheeling, backup and network charges should be published and should reflect the capacity and services actually provided.

The barriers most often encountered include:

- licensing thresholds set too low for modern facility sizes;
- single-buyer or exclusive-supply provisions that prohibit third-party ownership or supply;
- wheeling charges that are negotiated case by case rather than published;
- standby charges that are set without reference to the capacity actually reserved;
- prohibitions or tight caps on exporting surplus electricity;
- overlapping approvals from energy, environment, land and municipal authorities, with no single point of entry.

A number of member States have recently reformed these rules:

- **South Africa** removed the generation licensing threshold for embedded generation in 2022, replacing licensing with registration (Republic of South Africa, 2024).
- **Kenya** adopted the Energy (Electricity Market, Bulk Supply and Open Access) Regulations, 2024. These allow eligible consumers of at least 1 MVA on the distribution system or 10 MVA on the transmission system to seek open access and wheeling, at charges approved by the regulator and within fixed response times (Republic of Kenya, 2024).
- **Nigeria's** Electricity Act, 2023 allows states to regulate intrastate electricity markets. Lagos State enacted its own electricity law in 2024 (Mondaq, 2025).
- **Morocco** brought its self-generation framework into force in 2026 (Case-study 5).

Case-study 5: Morocco's self-generation framework (Law 82-21)

Morocco's Law 82-21 on self-generation of electricity is implemented through Decree 2.25.100, which entered into force in June 2026, and four decisions of the national electricity regulator (ANRE). The framework sets tiers by size:

- under 11 kW: a simple declaration;
- 11 kW to 5 MW: a connection agreement with the distribution operator after a technical study;
- above 5 MW: prior authorization from the national utility (ONEE).

Surplus injected into the grid is capped at 20 % of annual production and paid at regulated peak and off-peak rates. Use-of-system charges are published (6.85 centimes/kWh for the national transmission network and 6.07 centimes/kWh for the medium-voltage distribution network). Hosting capacity on the networks is also published (Médias24, 2026). Publishing charges and hosting capacity in this way gives investors a predictable basis for appraisal. Stakeholders continue to discuss whether the export cap should be revised as hosting capacity grows.

Policy actions:

- Publish a single, size-tiered approval route for own-use and third-party-owned on-site generation, with defined timelines.
- Publish cost-reflective wheeling, standby and backup charges, and the methodology behind them.
- Allow surplus export on published terms where the network can absorb it, and publish hosting capacity.
- Distinguish clearly between own use and supply to other customers, so that captive generation does not become an unregulated retail business.

5.1.3 Off-grid power integration

National rules should distinguish a private power system serving one campus from a mini-grid supplying several customers. A private system needs safety and interconnection conditions if it can operate alongside the grid. A shared mini-grid also needs a service area, customer protections, tariffs and rules for ownership of distribution assets. Grid expansion plans should give operators notice of when the main network is expected to arrive. They should also set out defined options for interconnection, continued service or transfer of assets, with a clear method of compensation. The contract should protect other customers if the data-centre anchor reduces its demand or closes.

Three configurations should be recognized in regulation:

- an **islanded private system**, serving one campus with no grid connection;
- a **grid-parallel private system**, serving one campus but able to import from or export to the grid;
- a **shared mini-grid**, serving the data centre and other customers.

Mini-grid regulations in several member States, including Nigeria, already set out what happens when the main grid arrives. The options typically include:

- conversion to a small power producer selling to the utility;
- continued operation as a distributor buying bulk power;
- transfer of assets at a defined compensation value.

These provisions should be extended explicitly to systems anchored by data centres. The anchor's departure should be treated as a foreseeable event with pre-agreed consequences, such as notice periods, exit payments, step-in rights or the conversion of the system to serve remaining customers.

5.1.4 Productive use of energy

Energy policy should assess the economic activity that a new supply arrangement enables, not only the amount of electricity generated or connected. Where a data-centre project seeks public support on the basis that it will benefit nearby enterprises or public services, the agreement should identify:

- those users;
- the connections and services to be financed;

- their expected price;
- the party responsible for delivery.

Authorities should verify uptake and use after commissioning.

This approach aligns with the national energy compacts under Mission 300, which emphasize productive use and private-sector participation (World Bank, 2025a). Suitable indicators include:

- the number of enterprises and public facilities connected;
- hours of supply and outage frequency;
- the tariff paid relative to alternatives such as diesel;
- enterprise revenue or employment where measurable.

Installed capacity alone is not a measure of development impact.

5.1.5 Integrated planning, siting and connection

Data-centre demand should be built into national integrated resource plans, transmission development plans and digital infrastructure plans, rather than handled case by case. Because many announced projects do not proceed, forecasts should weight demand by project maturity, for example by whether land, connection agreements and financing have been secured. Authorities can identify digital infrastructure zones where generation, transmission, fibre and Internet exchange points coincide, and prepare them with pre-assessed connection capacity, environmental approvals and land. Connection agreements for large loads should include milestones, financial security and provisions to release unused capacity, so that speculative applications do not block viable projects.

5.1.6 Energy efficiency, water and environmental performance

Because facilities in Africa operate at higher PUE than the global average, efficiency standards bring both economic and system benefits. Member States should consider the following measures:

- requiring new facilities above a defined size to report PUE, water usage effectiveness and the carbon intensity of their electricity;
- setting design-stage efficiency benchmarks appropriate to local climates;
- permitting or encouraging heat reuse where there is local demand;
- assessing water stress at proposed sites before approval;
- setting emission and noise standards for backup generation and encouraging a transition from diesel to batteries, gas or hybrid systems.

The IEA suggests that regulators encourage operators to use backup generation and storage more flexibly, which could support the grid during peaks (IEA, 2025b). Where safety and reliability allow, rules should let data-centre batteries provide grid services on published terms. Performance-based finance can reward verified improvements in PUE or emissions, and energy service company contracts can finance upgrades in existing facilities (Camarasa and Prata Dias, 2025).

5.1.7 Cost allocation, tariffs and protection of other consumers

When a large new load connects, other users should neither subsidize it nor lose supply because of it. Regulators should consider the following tools:

- cost-reflective tariff classes for large loads, with demand charges based on contracted capacity;
- minimum contract terms, minimum bills or exit fees, so that network investment made for a facility is not stranded if the facility leaves early;
- collateral or guarantees proportionate to the investment the utility makes on the customer's behalf;
- load-shedding and curtailment rules that state whether and when a large load may be interrupted, and on what compensation;
- transparent treatment of currency risk where tariffs are indexed to foreign currency.

These provisions protect household and enterprise consumers while giving investors certainty.

5.2 Towards an investment climate for data centres in Africa

5.2.1 Business models for energy investments for data centres

Each business model depends on three conditions:

- a credible customer load;
- a lawful route to supply the site;
- an agreement on who pays for generation, the network and backup.

Authorities should assess these obligations before awarding land, grid capacity, guarantees or tax support. The models below are not mutually exclusive: large facilities typically combine several, for example grid supply under a regulated tariff, a wheeled renewable PPA, on-site solar and storage, and gas or diesel backup. **Table IX** summarizes the models, the conditions they require, and their main risks.

Table IX Business models for supplying energy to data centres.

Model	Best suited to	Regulatory preconditions	Main risks and who should bear them
Public–private partnership for shared assets	Transmission lines, substations, shared energy systems serving several users	PPP law covering energy assets; fiscal commitment limits; contingent-liability reporting	Construction and performance risk (private); demand risk (party best able to manage it); fiscal risk capped by contract
Power purchase agreements (on-site, direct line, wheeled, utility products)	Colocation and hyperscale facilities seeking long-term, low-carbon supply	Open access and wheeling rules; published network charges; rules on ownership of renewable attributes	Curtailment, network availability, currency and price risk (allocated by contract)
Independent private energy investment (IPPs, storage, energy service companies)	Markets with competitive procurement and creditworthy offtakers	Proportionate licensing; competitive access to sites and networks; transparent tariffs	Offtaker credit risk; connection delay; public support limited to defined risks

Self-consumption (on-site or adjacent generation with grid supply)	Facilities with space and good solar or wind resource; weak or unreliable grids	Own-use approval route; metering; export and standby rules	Night-time and outage supply; over-estimation of displaced fossil generation
Mini-grid anchored by an edge facility	Secondary cities and rural hubs with identified other users	Mini-grid licence or permit; approved tariff; grid-arrival rules	Anchor departure or delayed demand growth; grid arrival
Productive-use scheme	Projects seeking public or concessional support on development grounds	Results-based finance rules; verification framework	Non-delivery of promised connections (developer or delivery partner)
Regional power pooling for regional data centres	Facilities serving several national markets	Cross-border trade rights; transmission access; scheduling and settlement; data law alignment	Firm delivery not guaranteed by pool membership; curtailment; legal fragmentation

***Source**: ECA.*

5.2.2 Public–private partnership models

A public–private partnership (PPP) can finance a defined public asset or shared service, such as a transmission line, a substation or an energy system serving several users. The procurement should specify:

- the public contribution;
- ownership and access rights;
- the service standard;
- the payment mechanism and performance deductions;
- termination terms.

Government and utility payment obligations should be costed over the life of the contract, with a stated fiscal limit. Demand risk should sit with the party able to manage it. Public guarantees should address identified risks rather than cover an open-ended commercial shortfall.

Tools such as the PPP Fiscal Risk Assessment Model (PFRAM) of the International Monetary Fund and the World Bank can help ministries of finance quantify direct and contingent liabilities before they commit (IMF and World Bank, 2019). Payment obligations and guarantees should be recorded in a public register of contingent liabilities. Where the data centre is the main user of a PPP asset, the payment mechanism should link public payments to availability and performance, and any shortfall arising from the data centre's demand should be borne by the data centre or its sponsor, not by the public budget.

5.2.3 Power purchase agreements and contractual models

Countries should enable on-site supply contracts, direct lines, wheeled power and utility supply products where their electricity-market structure permits. Standard terms should address:

- the volume and timing of delivery;
- curtailment, losses and balancing;

- network charges;
- price adjustment and currency risk;
- delay in connection works.

The contract should state who owns renewable attributes and how they are retired. It should also specify the supply available at night and during prolonged grid outages, because an annual renewable purchase alone does not meet a continuous load.

Table X Contractual structures for renewable supply to data centres.

Structure	How it works	Prerequisites	Key issues to settle
On-site or behind-the-meter supply	Generation on or adjacent to the site supplies the facility directly; may be owned by a third party under a lease or energy-services contract	Own-use approval; safety and interconnection rules	Limited by space; night-time supply; export of surplus
Direct line (private wire)	A dedicated line connects a nearby plant to the facility without using the public network	Legal right to build and operate a private line	Duplication of network assets; backup from the grid
Wheeled (physical) PPA	A remote generator injects power into the grid and an equivalent amount is credited to the facility	Open access; published wheeling and loss charges; metering and settlement	Network availability; curtailment; imbalance; municipal arrangements
Utility green tariff or sleeved supply	The utility buys renewable power and resells it to the customer as a specific product	Regulator approval of the product and tariff	Additionality; pass-through of costs; firmness
Virtual or financial PPA	A financial contract for differences tied to a renewable plant; physical supply comes from the grid	Liquid wholesale market or reference price	Not available in most African markets; basis risk

Source: *ECA.*

Firm supply is the central issue. A solar PPA can supply a large share of annual energy and still leave the facility dependent on fossil backup for most night-time hours. Contracts should therefore be appraised on an hourly basis. Hybrid portfolios that combine solar, wind, storage and dispatchable generation, or that are supported by a utility firming product, deserve particular policy attention. Where tariffs are denominated in foreign currency, the allocation of currency risk between generator, utility and customer should be explicit. Contracts should also provide for local-currency pricing where local-currency financing can be mobilized.

5.2.4 Private investment in energy models

Independent generators, storage providers and energy service companies should be able to finance assets against long-term customer contracts. To attract that capital, governments should use competitive access to sites and networks, transparent tariffs and proportionate licensing. Financing proposals should demonstrate committed demand, the customer's payment capacity and a practical

route to connection. Public credit support, where justified, should be limited to a defined risk, amount and period.

Data-centre offtake can improve the bankability of independent power projects because the offtaker is often more creditworthy than the national utility. Development finance institutions can complement this with partial risk guarantees, political risk insurance and local-currency facilities, and by providing early-stage capital in less mature markets. Concessional resources should be reserved for risks that markets cannot yet price, such as first-of-a-kind regulatory arrangements, rather than replacing commercial capital that is already available.

5.2.5 Self-consumption business models

A data centre may combine on-site or adjacent generation and storage with grid supply. Rules should permit ownership by the operator or by an energy service provider. They should also provide for metered imports and exports, payment for surplus power and a cost-reflective standby service. Project appraisal should use the hourly load and generation profile, including night-time demand and long outages, to establish how much conventional generation the arrangement can actually displace.

Experience shows why this matters:

- **Rack Centre, Nigeria.** The operator moved from diesel to gas-fired captive power with modular solar, cutting annual emissions by about 21.5 % and reaching a PUE of about 1.35. Its on-site solar offsets about 43 % of its first-phase operating load, but is designed to cover only about 5.5 % of the campus's planned 12 MW long-term capacity (ADCA and Rising Advisory, 2026a).
- **Phased hybrid approaches.** These typically begin with short-duration batteries for ride-through. They then add solar for 30–40 % of daytime load and longer-duration storage as facilities grow (Engineering News, 2026).

5.2.6 Mini-grid business models

An edge facility can be an anchor customer for a mini-grid serving businesses, households or public institutions, where those users and their demand are identified. The operator should have a licence or permit suited to the scale of supply, an approved tariff and service obligations to all customers. Financing and customer contracts should address delayed growth or departure of the anchor customer, and interconnection or compensation when the main grid arrives.

Decentralized renewable solutions provided 55 % of new connections in sub-Saharan Africa between 2020 and 2022 (World Bank and others, 2025). Mini-grids are therefore a mainstream electrification tool, not a niche. The World Bank's Energy Sector Management Assistance Program (ESMAP) has documented the role of anchor and productive loads in improving mini-grid economics (ESMAP, 2022). As digital services move to secondary cities, small edge facilities and telecommunications hubs can provide the predictable demand that makes a mini-grid viable. The regulatory question is how to protect the other customers if the anchor's plans change.

5.2.7 Productive use of energy business models

An anchor-led scheme can combine a long-term data-centre electricity contract with financed connections and equipment for local businesses. Any concessional funding should pay for a specified access or productive-use outcome, with beneficiaries, costs and verification set out in advance. Results should be measured through the enterprises and services using the power, their affordability and the continuity of supply, rather than through installed capacity alone.

Results-based financing, in which payments are released against verified connections or service levels, is well suited to this model. It can be blended with the national energy compact financing under Mission 300.

5.2.8 Regional power pooling and regional data centres

A regional data centre may serve several national markets from a location with suitable electricity and connectivity. Its energy plan should establish:

- the legal right to buy electricity across borders;
- transmission access;
- scheduling and settlement;
- the treatment of curtailment;
- a local continuity arrangement.

Participation in a regional power pool does not in itself secure firm delivery to a facility. The hosting arrangement should also settle applicable data law, lawful access, service recovery and exit, so that power and data agreements can operate together.

Africa's power pools are at different stages of development:

- **Southern African Power Pool.** Established in 1995, it operates day-ahead and other short-term markets, but traded volumes average about 2,100 GWh a year. Bilateral contracts between national utilities accounted for 68–90 % of traded volume in 2023–2024, and trade is limited by cross-border and internal transmission constraints (Engineering News, 2025).
- **West African Power Pool.** It conducted a synchronization test of its interconnected system in November 2025 as a milestone towards a regional electricity market (World Economic Forum, 2026).
- **Continental level.** The AfSEM and the CMP provide the long-term framework, envisaging an increase in installed capacity from about 266 GW to about 1,218 GW by 2040 (EEAS, 2023).

Until cross-border markets mature, regional data centres should combine pool access with firm national supply and on-site continuity arrangements. Data-governance alignment under the AU Data Policy Framework, the Malabo Convention and the AfCFTA Protocol on Digital Trade is equally important, because a regional facility is only viable if it can lawfully serve customers in several jurisdictions.

Chapter 6 Socioeconomic and Environmental Implications

This chapter should distinguish direct data centre impacts from wider digitally enabled economic effects and then assess how benefits, costs and environmental pressures are distributed.

6.1 The economics of data centers in Africa

Africa's data centre market combines large financing needs with a relatively small base of commissioned facilities. McKinsey estimates data centre demand could reach 1.5–2.2 GW by 2030 and that US$10–20 billion of core-and-shell investment could be required (Jayaram et al., 2025). A bankable project must cover more than the building shell and incorporate land and permits, civil works, electrical and cooling systems, network interconnection, backup and storage, fiber connectivity, IT hardware where applicable, maintenance, financing costs, and replacement cycles. Electricity reliability and customer occupancy are decisive because debt service begins before an expandable facility necessarily reaches full utilization. Governments should therefore appraise development proposals by phase, using secured tenants and expected operating load rather than assuming that nameplate MW represents demand or revenue (ADCA, 2026a; Jayaram et al., 2025).

Sources of capital and financing structures can be assembled from sponsor equity, infrastructure and private-equity funds, strategic cloud or telecommunications investors, commercial or development-bank debt, and—in sufficiently developed markets—capital-market investors. Public capital should prioritize shared assets and market failures, such as transmission connections, skill development, and viable digital public services, rather than underwrite ordinary commercial occupancy risk. UNCTAD (2025) documents international digital investment and continuing underinvestment in core digital infrastructure across developing economies. Africa's access to finance thus depends on credible pipelines and policies as well as global investor appetite.

> **Case-study 6: IFC-supported Raxio platform — Illustrative African transaction**
>
> The International Finance Corporation (IFC) records an investment of up to US$100 million for a phased, ten-site carrier-neutral metro-edge data-centre portfolio in seven African markets, with disclosed total project cost of approximately US$293 million and planned capacity of 13.5 MW. The investment record identifies blended-finance support and shows how a multi-country platform can aggregate smaller markets; it is a project-specific example, not a per-MW cost benchmark.
>
> ***Source**: International Finance Corporation (IFC). (2026). Raxio DC (Project No. 48537): Summary of investment information.*

De-risking should follow a clear sequence: independently verify market demand; phase construction against pre-leases or anchor contracts; obtain enforceable power and fiber connection terms; test grid, climate, water, and site conditions; and allocate construction, exchange-rate, off-taker, regulatory and political risks to parties best able to manage them. Standardized permits, wheeling rules, tariff methodologies and dispute mechanisms reduce policy uncertainty. Where warranted, development-finance debt, limited guarantees, political-risk insurance or local-currency structures can address specific financing gaps, with publicly reported exposure ceilings and termination provisions (IFC, n.d.; World Bank, 2026a)

6.2 Economic Benefits and Domestic Value Creation

The economic impact of data centres is multifaceted creating direct, indirect, and induced economic benefits. Direct impacts are capital expenditure, construction contracts, permanent operations jobs and payments made by the facility. Indirect impacts arise in domestic supply chains supplying engineering, security, maintenance, power services and professional support. Induced or digitally enabled effects occur when businesses and public agencies use hosting, cloud, analytics and AI services to improve productivity, deliver services and create new products. These last effects are potentially important but cannot be attributed to data-centre construction alone as they depend on broadband, adoption, competition, complementary skills, and reliable electricity (World Bank, 2023; United Nations Economic Commission for Africa [UNECA], 2026).

Construction can generate substantial temporary labor demand, while steady-state operations typically require a smaller, more specialized workforce. Skills and procurement strategies should therefore focus on durable capabilities: electrical and mechanical engineering, facility management, cybersecurity, network operations, software and cloud administration, and equipment repair. Procurement agreements can publish feasible local-sourcing targets and establish apprenticeships with technical institutions; impact assessments should report actual local full-time-equivalent jobs, wage quality, accredited trainees and the local value of purchases rather than unsupported employment multipliers (World Bank, 2023; World Bank, 2026a).

Data sovereignty and domestic value creation are related but different. Hosting information locally may reduce latency and exposure to some foreign infrastructure risks, yet it does not by itself ensure that African firms own software, retain intellectual property, control access to data or capture platform profits. The African Union Data Policy Framework (AUDPF) favors interoperable, trusted cross-border data governance; governments should pair hosting investment with enforceable privacy, cybersecurity, fair competition, public-procurement interoperability and opportunities for African cloud and application providers. Fiscal benefits should be measured net of tax holidays, subsidised electricity, public land concessions and contingent guarantees (African Union Commission [AUC], 2022; UNCTAD, 2025).

6.3 Social Inclusion and Distributional Implications

The benefits of local computing facilities are likely to be geographically uneven. Most of the continents data center capacity are concentrated in five major countries: South Africa, Egypt, Nigeria, Kenya, and Morrocco. The current investment concentration around commercially viable cities and fiber routes can deepen disparities between major metropolitan hubs, secondary cities and landlocked countries. The International Telecommunication Union (ITU, 2025) estimates that 36% of people used the internet in its Africa. Without affordable broadband, devices and skills, proximity to a data centre may have little direct effect on excluded communities.

Inclusion policy should promote competitive access to hosting and interconnection, local internet-exchange infrastructure, secure public cloud procurement, and regional service arrangements that allow smaller economies to buy capacity without duplicating hyperscale campuses. Remote

regions may benefit more from resilient fiber, exchange points, and modest edge facilities than from large local campuses whose utilization is uncertain. Public procurement can also create predictable demand for services while requiring open standards, portability and protection of personal data (AUC, 2022; World Bank, 2026a).

Distributional appraisals must also consider who bears costs: consumers exposed to tariff increases or weaker supply; residents affected by land acquisition, noise or diesel emissions; water users during drought; and workers excluded from specialized jobs. Conditions attached to public support should include stakeholder consultation, transparent grievance procedures, fair compensation where required, targeted training for women and youth, and disaggregated monitoring of beneficiaries and adverse effects. These are project safeguards and proposed accountability criteria—not outcomes already demonstrated by the current African project pipeline (UNECA, 2026; UNCTAD, 2024).

6.4 Economic Trade-offs, Environmental Impacts and Sustainability

6.4.1 Energy-access and economic opportunity costs

Unlike developed nations Africa faces a significant and persistent power deficit exacerbated by frequent load shedding and outages, rapidly growing electricity demand from household and industry, and low reserve margins to meet those demands. The opportunity cost of a new large electricity load is greatest where networks are already constrained. Almost 600 million people in Africa lack electricity access, and the IEA estimates that universal access by 2035 would require around US$15 billion annually (IEA, 2025e). Connecting large data centre driven load without firm additional supply can crowd out industry and household electrification, even when its demand is modest relative to national annual generation. The relevant appraisal compares local peak capacity, tariffs, public investment and counterfactual productive uses at the actual grid node (IEA, 2025b, 2025e).

Regulators can limit these effects by requiring verified grid capacity, staged connection rights, published reinforcement cost-sharing, and investment in additional generation or firming resources where needed. Shared electricity infrastructure may produce a positive local externality, but only if contracts specify who pays when new capacity becomes available, how other consumers benefit and what happens if the facility reduces demand. Dedicated power projects should not be counted as benefits to communities unless new connections or measurable service improvements materialize (IEA, 2025e; World Bank, 2026a). If proper implantation framework and clear agreements are in place, data centres can ignite power production projects by being anchor tenant (ADCA, 2026a). Moreover, decoupled energy infrastructure developments undertaken by data centres such as through min-grid and excess captive energy sharing could ultimately benefit local communities.

An access-impact assessment should compare a documented “without-project” electrification program with the plan after the data-centre connection. It should identify any change in the number and timing of household, business and public-service connections, and in the financing available

for the networks. If the developer funds shared grid infrastructure or anchors a mini-grid, claimed community benefits should be conditional on financed distribution extensions, affordable connection arrangements and verified service delivery—not simply on surplus generating capacity or a promised future connection (IEA, 2025e).

6.4.2 Carbon emissions and energy footprint

Data-center related emissions are expected to rise unless electricity systems decarbonize rapidly. A facility's climate footprint can be broken down across three scopes: i) main operational electricity emissions, ii) diesel or gas backup and refrigerants, and iii) embodied emissions in construction and computing equipment manufacturing. Electricity-related emissions vary with local grid source and intensity and actual hourly procurement. If data-center growth relies on coal, gas, or diesel generation as their main source of power, emissions may become locked in for decades. Although facilities should take the initiative to be environmentally conscious with proper validation, it does not automatically make every operating hour carbon-free. Claims should disclose measured site electricity, market- and location-based emissions where relevant, new renewable-project additionality, backup fuel and material lifecycle assumptions (IEA, 2025b; UNCTAD, 2024; European Commission, 2026).

6.4.3 Water use, land and e-waste

Cooling choice creates a site-specific trade-off between energy and water. Many data centre cooling technologies consume substantial amount of fresh water which creates additional challenges for already water stressed African regions. On Average, a 1 MW site can consume up to 25.5 million liters of water a year for cooling, enough to accommodate 300,000 peoples' need each day (UNECA, 2026). Another reason why the issue of water use is significant is the fact that most of the African continent has warmer weather which elevate the use of water for cooling purposes. One mitigating strategy is to focus data centre development around cooler climate regions. Site approval should account for seasonal catchment stress, access to non-potable or reclaimed water, wastewater treatment and dry-cooling electricity penalties. The screening area should cover affected water users and ecosystem services, not merely the project boundary (Kuzma et al., 2023; UNCTAD, 2024).

Water allocation creates a further opportunity cost beyond a facility's own consumption. Cooling withdrawals from municipal systems, aquifers or river basins may compete with drinking-water and sanitation services, irrigated agriculture, food processing, other businesses and environmental flows that sustain ecosystems. The trade-off can be more acute during dry seasons and heatwaves, when water availability may decline. The World Bank (2024) identifies reliable water supplies as essential to agricultural productivity, employment, public health and ecosystem services and calls for coordinated, equitable water allocation. Consequently, water usage effectiveness (WUE) and annual water totals are not enough: assessment should distinguish water withdrawals from consumptive use and compare seasonal project demand with other existing and planned uses, local water infrastructure costs and climate-related scarcity (Kuzma et al., 2023; World Bank, 2024).

Case-study 7: South Africa ─ Teraco's Industry-Leading Water Usage Effectiveness (WUE)

Teraco provides a noteworthy example of how data-center growth can be decoupled from water consumption through efficient design and operations. In its 2026 Sustainable Impact Report, the company reported a Water Usage Effectiveness (WUE) of just 0.03 liters per kWh in 2025, which it describes as an industry-leading performance. Remarkably, Teraco achieved this level of efficiency even as its IT footprint doubled since 2023, consuming less than two tablespoons of water for every IT kilowatt-hour used for cooling. The company attributes this outcome to deliberate investments in next-generation cooling technologies, optimized operational practices, rainwater harvesting, and reduced reliance on municipal water supplies. In the context of South Africa's water scarcity challenges, Teraco's approach demonstrates that large-scale digital infrastructure can be expanded while maintaining extremely low water intensity, providing a practical model for sustainable data-center development across Africa.

***Source**: Teraco. (2026). Sustainable Impact Report 2026.*

The appraisal should consider the value of the most plausible alternative uses of scarce water—for example, irrigation, community water supply or water-dependent enterprises—while avoiding the assumption that every liter requested by a facility would otherwise be productively used. Mitigation options include reducing cooling demand, using treated wastewater where doing so does not displace existing downstream users, and selecting cooling systems on combined water, energy and life-cycle costs. In water-stressed catchments, permits should set monitored withdrawal limits and drought-response rules and require consultation with affected users; a low-WUE design alone cannot establish that local water allocation is equitable (World Bank, 2024; UN Trade and Development, 2024).

Land conversion, heat rejection, construction materials, and equipment replacement also matter. The global e-waste evidence shows why specialist end-of-life controls are needed. Less than 1% of e-waste generated in Africa was documented as formally collected and recycled in 2022; this is a regional all-electronics statistic, not a measured data-centre waste rate (International Telecommunication Union and United Nations Institute for Training and Research, 2024). Operators should maintain equipment inventories, certified reuse and recycling pathways, hazardous battery handling and secure data destruction with auditable records.

6.4.4 Managing economic and environmental trade-offs

Project approval and investment incentives should rest on a measurable development-and-sustainability screen rather than on capacity or pledged investment alone. **Table XI** sets out proposed minimum indicators for feasibility approval and annual monitoring; thresholds should be calibrated to national law, grid conditions and local resource risks. The approach builds on the reporting logic in the European Commission's data-centre framework as such it is only a proposal for African adaptation for formulating a continent-wide standard (European Commission, 2026).

An effective implementation would require baseline environmental and socioeconomic impact assessments, time-bound mitigation plans, transparent publication of core performance indicators and independent verification for larger sites. To foster proper implementation, incentives could be

conditional on verified local skills and value creation, renewable and grid investment, meaningful access benefits, and compliance with environmental safeguards.

Table XI Proposed project-level assessment and disclosure scorecard.

Assessment dimension	Proposed indicator and verification requirement
Bankability & public value	Document committed tenants, staged financing, local procurement and jobs; disclose the net fiscal cost of incentives and guarantees.
Power-system additionality	Verify contracted MW/MVA, connection reinforcement, incremental clean generation and no or minimal deterioration in service or tariffs for others. Also record whether planned new household, enterprise, school and clinic connections are delayed or advanced, with verified dates and beneficiary numbers.
Carbon & efficiency	Report annual facility/IT MWh, measured PUE, backup fuel, grid-emission assumptions and time-specific clean-power matching.
Water & climate resilience	Disclose site WUE, annual withdrawals/consumption, catchment stress, permitted discharges and extreme-weather resilience tests. Compare dry-season withdrawals and consumption with domestic supply, agriculture, industry and environmental-flow needs; document displaced uses and mitigation.
Circularity & land	Verify land and livelihood safeguards, equipment life-extension, secure reuse, certified e-waste recycling and battery disposal.
Inclusion & accountability	Track local skilled jobs, trainees by gender, access and productive-use outcomes, consultations, grievances and independent audit.

Chapter 7 Pathways for Sustainable Data Centre Development in Africa

The chapter outlines policy, regulatory, investment, and infrastructure measures needed to support the growth of a resilient and competitive data-centre ecosystem. It also highlights opportunities to accelerate renewable energy adoption, improve energy efficiency, mobilize investment, and strengthen regional cooperation.

7.1 Context

Africa's accelerating digital transformation is increasing demand for the infrastructure needed to store, process and transmit data. Growth in internet use, cloud computing, artificial intelligence, digital financial services, e-government and demand for local data hosting is driving expansion of the continent's data centre industry. Although the market remains concentrated in major hubs such as South Africa, Kenya, Nigeria, Egypt and Morocco, emerging markets including Ghana, Rwanda, Ethiopia, Senegal and Côte d'Ivoire are increasingly attracting attention. Data centres have the potential to become critical enablers of Africa's digital economy, but their sustainable expansion depends on addressing significant constraints related to energy, water, environmental impacts, financing, skills, policy and regulation (Walter et al., 2025).

The sustainable development of Africa's data centre industry therefore requires approaches that reconcile growing digital and artificial-intelligence demand with energy, water and climate considerations (SSCG Group, n.d.). There is no single model that can be applied uniformly across the continent. National circumstances differ considerably in terms of energy resources, climate, water availability, digital connectivity, regulatory capacity and market development. Sustainable pathways must consequently be context-specific, resilient, affordable, scalable and inclusive Net Zero Insights (n.d.).

Drawing on empirical evidence from the previous chapters, this chapter proposes an integrated approach based on renewable and resilient energy systems, efficient cooling and water management, sustainable design and construction, strategic location and regional integration, innovative financing, skills development, and community participation. It also proposes complementary actions by national governments, regional institutions, development partners, the private sector, civil society and academia. The chapter identifies practical pathways for African countries to expand data centre infrastructure while addressing sustainability constraints.

7.2 Measures/pathways for a resilient and competitive data centre

Policy and regulatory pathway

The enabling policy environment is critical for a resilient data centre. National digital economy and broadband strategies influence connectivity and demand for data infrastructure, while energy regulations covering independent power producers, power purchase agreements, electricity wheeling and net metering determine the extent to which data centre operators can obtain reliable renewable electricity. Environmental and building standards influence facility design, while data protection, cybersecurity and localization policies affect demand for domestic hosting. Regional

initiatives, including the African Union Data Policy Framework, the African Continental Free Trade Area and regional power pools such as SAPP, EAPP, WAPP and CAPP, offer opportunities to coordinate energy, data and infrastructure markets across national boundaries.

Energy, cooling, and water pathway

A central pathway for sustainable development is transitioning towards reliable and renewable energy. Hybrid renewable microgrids combining solar generation, battery storage and suitable backup systems offer an important option, especially where national grids remain unreliable. Electricity wheeling, green tariffs and corporate power purchase agreements can provide additional mechanisms for operators to obtain renewable electricity where regulatory systems permit them. Artificial intelligence and advanced energy-management systems can also improve efficiency by aligning computing demand with electricity availability and optimizing energy consumption. Location decisions should increasingly consider proximity to renewable resources. Emerging technologies such as green hydrogen and small modular reactors may eventually provide additional energy options, although their costs, technological maturity and regulatory requirements mean that they should be approached cautiously.

Improving cooling and water management is equally important. Closed-loop systems and dry cooling can reduce water consumption, particularly in arid environments, while liquid cooling is becoming increasingly relevant for artificial intelligence and other high-density computing applications. Data centres should prioritize recycled and non-potable water where feasible and establish measurable water-use-efficiency targets. Opportunities also exist to recover waste heat from facilities for use by nearby buildings or industries.

Location and regional integration pathway

Strategic location and regional integration provide another important pathway. Africa's renewable-energy resources vary considerably across regions: North Africa has substantial solar resources, East Africa possesses significant geothermal potential, and parts of Central Africa have considerable hydropower resources. Locating data infrastructure near renewable-energy resources can improve access to lower-carbon electricity. At the same time, edge data centres located near major demand centres can reduce latency and support locally delivered digital services. Regional data corridors and stronger interconnection between markets could complement these approaches, while green special economic zones could allow data centres and related industries to share electricity, connectivity and other infrastructure under coordinated investment and regulatory arrangements.

Financing and investment pathway

Financing remains a major consideration because the scale of investment required cannot be met through conventional public financing alone. Blended finance, green bonds and development finance institution support can mobilize additional capital, while guarantees and other de-risking instruments can improve project bankability. Feasibility studies, technical assistance and support for commercially viable project structures are also important during project preparation. Carbon-

market mechanisms and carefully designed tax incentives may provide additional support. Local-currency financing can help reduce foreign-exchange exposure, while public-private partnerships can combine private capital and expertise with broader public-development objectives.

Investment in physical infrastructure must be accompanied by development of human and institutional capabilities. Workforce training, STEM education and professional certification programmes are required to address skills shortages, while local research, development and innovation hubs can adapt technologies and business models to African conditions. Data centre investments should also deliver tangible benefits to surrounding communities through employment, local procurement and, where feasible, improved access to energy and water infrastructure. Effective stakeholder engagement should therefore form an integral part of project planning and implementation.

7.3 Policy priorities and stakeholder responsibilities

National governments have a central role in creating enabling environments for sustainable data centre development. Data centres should be explicitly integrated into national digital, energy and climate strategies. Governments should streamline permitting procedures for data centres and renewable-energy projects while maintaining appropriate environmental and social safeguards. Regulatory systems should facilitate power purchase agreements, electricity wheeling and green tariffs and establish clear water-use and efficiency standards. Skills development and local-content measures should complement these reforms so that infrastructure expansion contributes to domestic employment and technological capabilities.

Regional organizations, including the African Union, Regional Economic Communities and regional power pools, can complement national measures through greater harmonization and integration. Priorities include harmonizing relevant standards and certification systems, promoting cross-border electricity trade, facilitating regional data corridors, developing regional guidelines for green data centres and establishing mechanisms for sharing knowledge and experience across countries.

Development partners and development finance institutions can support implementation through concessional financing, guarantees, feasibility studies and technical assistance. They can also finance demonstration projects and skills programmes and help ensure that investment contributes to the Paris Agreement and Sustainable Development Goals.

The private sector has an equally important responsibility. Operators should establish measurable targets for energy efficiency, water consumption and carbon performance and transparently report against sustainability indicators. Investment in local skills and research and development should accompany physical infrastructure investment, while collaboration on shared infrastructure can improve efficiency and reduce duplication.

Civil society organizations and academic institutions can strengthen accountability by monitoring social and environmental impacts, advocating for community benefits, undertaking context-specific research and strengthening domestic capacity for policy analysis.

7.4 Conclusion

Africa's digital transformation will increasingly depend on robust data infrastructure capable of supporting artificial intelligence, cloud computing, fintech, e-government and other digital services. However, expansion of data centres cannot be considered independently of the continent's energy, water, climate and broader development challenges. Dependence on unreliable electricity, carbon-intensive backup generation or unsustainable water consumption could create new vulnerabilities even as countries seek to address their digital infrastructure gaps.

The more sustainable pathway is to develop a data centre ecosystem in which digital transformation and sustainable development reinforce each other. Renewable and resilient electricity systems, efficient cooling and water management, environmentally responsible design, strategic location, regional integration, innovative financing, workforce development and meaningful community participation constitute complementary elements of such an approach.

Achieving this objective requires coordinated action across multiple stakeholders. Governments need to establish predictable and enabling regulatory environments; regional institutions need to advance harmonization and cross-border integration; development partners and financial institutions can mobilize and de-risk investment; and private operators need to improve environmental performance and transparency. Academia, civil society and local communities also have important roles in research, oversight, capacity building and ensuring that the benefits of investment are broadly shared.

Ultimately, the objective is not simply to increase Africa's data centre capacity, but to build a sustainable, resilient and inclusive data centre ecosystem that supports the continent's digital transformation while simultaneously advancing its energy, climate and socioeconomic development objectives.

Chapter 8 Conclusion and Roadmap

Building on the analysis and recommendations presented in the report, the chapter outlines a roadmap for advancing sustainable data-centre development across the continent. It identifies priority actions for governments, regional institutions, utilities, investors, development partners, and industry stakeholders to strengthen the enabling environment for investment, accelerate the deployment of sustainable energy solutions, and support the growth of a resilient, competitive, and inclusive digital economy.

8.1 Recommendations

The recommendations below are grouped by the actors best placed to implement them.

8.1.1 Member States (ministries of energy, digital economy, finance and investment)

- Integrate data-centre demand into national energy and digital infrastructure plans, using forecasts weighted by project maturity.
- Establish a single, time-bound approval route for data-centre energy arrangements, coordinated across energy, environment, land and investment authorities.
- Before awarding land, grid capacity, guarantees or tax support, require an assessment of who pays for generation, the network and backup, using the checklist in annex I.
- Cost any capacity payments, guarantees or other contingent liabilities over the life of the contract against a stated fiscal limit, and record them in a public register.
- Where public support is justified by wider benefits, specify beneficiaries, services, prices and verification in the agreement.
- Align data-localization and data-protection rules with the AU Data Policy Framework, the Malabo Convention and the AfCFTA Protocol on Digital Trade, so that regional facilities are legally viable.

8.1.2 Energy regulators

- Publish cost-reflective wheeling, standby, backup and network charges and the methodologies behind them.
- Adopt a size-tiered regime for own-use and third-party on-site generation, and a clear distinction between own use and supply to others.
- Establish rules for customer-funded network investment, ownership transfer and contributions from later users.
- Introduce milestone-based connection queues with financial security and release of unused capacity.
- Adopt large-load tariff provisions (contracted-capacity charges, minimum terms and exit fees) that protect other consumers.
- Extend mini-grid regulations to cover data-centre-anchored systems, including anchor departure and grid arrival.

8.1.3 Utilities and system operators

- Publish available hosting and connection capacity by network location.

- Develop standard connection, wheeling and firming products for large customers.
- Agree protocols for data-centre storage and backup generation to provide grid services where safe and beneficial.
- Use data-centre revenues to support network reinforcement that also serves other customers.

8.1.4 Regional economic communities, power pools and regional regulators

- Develop model provisions for cross-border supply to large consumers, covering trading rights, transmission access, scheduling, settlement and curtailment.
- Prioritize the interconnectors and market mechanisms that would allow firm cross-border supply to regional digital hubs.
- Strengthen the enforcement powers of regional regulators so that market rules can be applied consistently.

8.1.5 African Union Commission, AUDA-NEPAD and continental institutions

- Integrate digital infrastructure demand, including AI compute, into the CMP and AfSEM implementation.
- Promote harmonized minimum efficiency, water and reporting standards for data centres.
- Link the implementation of the Continental AI Strategy with energy planning, so that compute ambitions are matched by supply.

8.1.6 Economic Commission for Africa

- Implement the case-study programme set out in chapter 5 and publish a comparative synthesis.
- Develop model regulatory provisions and contract clauses, and a fiscal-risk screening tool for data-centre energy transactions, in collaboration with partners.
- Provide technical assistance and peer learning for member States, and convene regulators, utilities, operators and financiers.
- Track data-centre energy indicators across member States as part of ECA's statistical and policy work on the digital economy.

8.1.7 Development finance institutions and partners

- Direct concessional resources and guarantees to defined risks in first-of-a-kind transactions, such as wheeling, independent transmission and anchor-led mini-grids.
- Support local-currency financing and hedging instruments to reduce currency mismatch.
- Use results-based finance for productive-use outcomes linked to data-centre projects, in coordination with Mission 300 compacts.

8.1.8 Data-centre operators and investors

- Disclose load, PUE, water usage effectiveness, energy sources and backup use in a consistent format.
- Appraise renewable supply on an hourly basis and report the share of load met by renewable energy at night and during outages.

- Structure projects to contribute to shared network capacity and local access where commercially feasible.

8.2 Key observations and conclusions

Africa's digital ambitions and its electrification agenda are now tightly linked. The continent will need much more data-centre capacity to deliver sovereign, affordable and secure digital services and to take part in the AI economy. That capacity will need reliable, increasingly renewable electricity. Data centres can help finance the generation and network investment Africa needs, but only if the rules let private capital in, the contracts allocate costs clearly, and public support is linked to defined risks and verifiable outcomes.

The measures in this paper are practical and largely within the authority of national governments and regulators. They concern clear approval routes, published charges, sound rules for network investment and mini-grid integration, disciplined fiscal assessment and regional arrangements that link power and data. Implemented together, they would allow member States to attract data-centre investment on terms that strengthen their power systems and widen access to electricity.

References

African Data Centres Association (ADCA) & Oxford Business Group (OBG). (2024). *Data centres and digital infrastructure in Africa*. Oxford Business Group.

African Data Centres Association (ADCA). (2024). *White paper: African climate and datacenter PUE 2024*. https://africadca.org/en/white-paper-african-climate-and-datacenter-pue-2024

African Data Centres Association (ADCA). (2025). *ADCA insider survey 2025*. African Data Centres Association. https://africadca.org/wp-content/uploads/2025/06/ADCA-INSIDER-SURVEY-2025-Website.pdf

African Data Centres Association (ADCA). (2026a). *Data centres in Africa 2026: The economic report*. https://africadca.org/wp-content/uploads/2026/02/DataCentresInAfrica2026-EN.pdf

African Data Centres Association (ADCA). (2026b). *White paper: African climate & datacenter PUE 2026*. https://africadca.org/en/white-paper-african-climate-datacenter-pue-2026

African Development Bank (AfDB). (2025). *Estimating investment needs for the power sector in Africa 2023-2030*. https://www.afdb.org/en/documents/estimating-investment-needs-power-sector-africa-2023-2030-africa-report

African Union Commission (AUC). (2020). *The Digital Transformation Strategy for Africa (2020–2030)*. Addis Ababa.

African Union Commission (AUC). (2022). *AU data policy framework*. African Union. https://au.int/en/documents/20220728/au-data-policy-framework

African Union Commission (AUC). (2024a). *AU data policy framework*. African Union. https://au.int/sites/default/files/documents/42078-doc-DATA-POLICY-FRAMEWORKS-2024-ENG-V2.pdf

African Union Commission (AUC). (2024b). *Continental Artificial Intelligence Strategy*. Addis Ababa.

Atlantic Council. (2026). *Powering data centers in emerging markets*. https://www.atlanticcouncil.org/wp-content/uploads/2026/04/powering-data-centers-in-emerging-markets.pdf

Baker McKenzie. (2026). *South Africa: the megawatt and the token – Africa's compute equation*. 11 June. https://www.bakermckenzie.com/en/insight/publications/2026/06/south-africa-the-megawatt-and-the-token-africas-compute-equation

Balabanyan, A., Semikolenova, Y., Singh, A., & Lee, M. A. (2021). *Utility performance and behavior in Africa today (UPBEAT): Summary report (Executive summary)*. World Bank. https://documents1.worldbank.org/curated/en/806071628829645284/pdf/Executive-Summary.pdf

Camarasa, Clara, and Gabriela Prata Dias. (2025). *Business Models and Finance to Enhance Energy Efficiency in AI and Data Centres in Emerging Economies*. Policy brief. Copenhagen: UNEP Copenhagen Climate Centre. https://unepccc.org/wp-content/uploads/2025/10/business-models-and-finance-ai-data-centres-policy-brief.pdf

Centre for Intellectual Property and Information Technology Law (CIPIT). (2026). *Data governance across Africa: Mapping of data protection laws*. Strathmore University. https://cipit.strathmore.edu/ai_dashboard/data-governance-across-africa-mapping-of-data-protection-laws/

Chen, X., Wang, X., Colacelli, A., Lee, M., & Xie, L. (2026). Electricity demand and grid impacts of AI data centers: Challenges and prospects. *Nexus*. Advance online publication. https://doi.org/10.1016/j.nexus.2026.100162

Commission for Regulation of Utilities. (2025). *The CRU publishes its decision on new electricity connection policy for data centres*. https://www.cru.ie/about-us/news/the-cru-publishes-its-decision-on-new-electricity-connection-policy-for-data-centres/

DatacenterDynamics. (2024). *Microsoft and G42 to build geothermal-powered data center in Kenya*. May. https://www.datacenterdynamics.com/en/news/microsoft-and-g42-to-build-geothermal-powered-data-center-in-kenya

DC Atlas. (n.d.). *Types of data centres*. https://dcatlas.io/en/learn/dc-fundamentals/introduction/types-of-data-centres

DC Byte. (2025). *Nordic data centre market sustainability*. https://www.dcbyte.com/news-blogs/nordic-data-centre-market-sustainability/

Donnellan, D., & Lawrence, A. (2024). *Annual outage analysis 2024*. Uptime Institute Intelligence. https://intelligence.uptimeinstitute.com/resource/annual-outage-analysis-2024

Donnellan, D., & Weinschenk, R. (2025). *Uptime Institute global data center survey 2025: Regional view (UII Data Report 183)*. Uptime Institute Intelligence. https://intelligence.uptimeinstitute.com/sites/default/files/2025-08/UI%20Field%20report%20183_Annual%20survey%20-%20regional%20view%202025.pdf

EEAS (European External Action Service). (2023). *Powering Africa's future: key documents officially adopted pave the way for a sustainable African Single Electricity Market*. 18 September. https://www.eeas.europa.eu/delegations/african-union-au/powering-africa%E2%80%99s-future-key-documents-officially-adopted-pave-way-sustainable-african-single_en

Energy for Growth Hub. (2025). *Are data centers Africa's next big bet?* By Daniel Johansson and Hamna Tariq. 14 February. https://energyforgrowth.org/article/are-data-centers-africas-next-big-bet/

Energy-Pedia. (2025). *Echelon to establish Ireland's first green energy park at data centre campus in Wicklow*. https://www.energy-pedia.com/news/ireland/echelon-to-establish-ireland%E2%80%99s-first-green-energy-park-at-data-centre-campus-in-wicklow-205693

Engineering News. (2024). *Teraco starts building 120 MW solar power plant to wheel power to its data centres*. 12 November. https://www.engineeringnews.co.za/article/teraco-starts-building-120-mw-solar-power-plant-towheel-power-to-its-data-centres-2024-11-12

Engineering News. (2025). *The Southern African Power Pool looks ahead to growth as it marks 30 years*. 28 March. https://www.engineeringnews.co.za/article/the-southern-african-power-pool-looks-ahead-to-growth-as-it-marks-30-years-2025-03-28

Engineering News. (2026). *Beyond diesel – rethinking power for Africa's data centres*. 27 March. https://www.engineeringnews.co.za/article/beyond-diesel---rethinking-power-for-africas-data-centres-2026-03-27

ESMAP (Energy Sector Management Assistance Program). (2022). *Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers*. Washington, D.C.: World Bank.

Euroheat & Power. (n.d.). *Datacentre, the Netherlands (Amsterdam), in operation*. https://www.euroheat.org/dhc/knowledge-hub/1-17-datacentre-the-netherlands-amsterdam-in-operation

European Commission. (2026). *Energy performance of data centres*. https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive/energy-performance-data-centres_en

Fortune Business Insights (FBI). (2025). *Data center market*. Market Research. https://www.marketresearch.com/Fortune-Business-Insights-Pvt-Ltd-v4286/Data-Center-38140185/

Gelvanovska-Garcia, N., Mačiulė, V., & Rossotto, C. M. (2024). *Advancing cloud and data infrastructure markets: Strategic directions for low- and middle-income countries*. World Bank. https://doi.org/10.1596/978-1-4648-2065-6

GlobeNewswire. (2025). *Africa data center market landscape report 2025-2030: Africa's data center market set to nearly double, valued at $6.81 billion by 2030*. https://www.globenewswire.com/news-release/2025/04/24/3067389/28124/en/Africa-Data-Center-Market-Landscape-Report-2025-2030-Africa-s-Data-Center-Market-Set-to-Nearly-Double-Valued-at-6-81-Billion-by-2030.html

GSMA. (2025). *The state of the industry report 2025*. GSMA. https://www.gsma.com/sotir/wp-content/uploads/2025/04/The-State-of-the-Industry-Report-2025_English.pdf

IMF (International Monetary Fund) and World Bank. (2019). *PPP Fiscal Risk Assessment Model (PFRAM 2.0)*. Washington, D.C.

Infocomm Media Development Authority (IMDA). (2024). *Singapore launches world's first liquid cooling standard for data centres in tropical climates*. https://www.imda.gov.sg/resources/press-releases-factsheets-and-speeches/singapore-launches-worlds-first-liquid-cooling-standard-for-data-centres-in-tropical-climates

Intelligent CIO. (2025). *NVIDIA and Cassava Technologies launch $700m AI data centre rollout across Africa*. 27 November. https://www.intelligentcio.com/africa/2025/11/27/nvidia-and-cassava-technologies-launch-700m-ai-data-centre-rollout-across-africa/

Intelpoint. (2026). *South Africa accounts for 25% of Africa's 249 data centres*. https://intelpoint.co/insights/south-africa-accounts-for-25-of-africas-249-data-centres/

International Energy Agency (IEA). (n.d.). *Artificial intelligence*. IEA. https://www.iea.org/topics/artificial-intelligence

International Energy Agency (IEA). (2022). *Advancing decarbonisation through clean electricity procurement*. https://www.iea.org/reports/advancing-decarbonisation-through-clean-electricity-procurement

International Energy Agency (IEA). (2024). *Executive summary*. In *Clean energy investment for development in Africa*. IEA. https://www.iea.org/reports/clean-energy-investment-for-development-in-africa/executive-summary

International Energy Agency (IEA). (2025a). *Data centre electricity use surged in 2025 even with tightening bottlenecks driving a scramble for solutions*. IEA. https://www.iea.org/news/data-centre-electricity-use-surged-in-2025-even-with-tightening-bottlenecks-driving-a-scramble-for-solutions

International Energy Agency (IEA). (2025b). *Energy and AI*. https://www.iea.org/reports/energy-and-ai

International Energy Agency (IEA). (2025c). *Executive summary*. In *Key questions on energy and AI*. IEA. https://www.iea.org/reports/key-questions-on-energy-and-ai/executive-summary

International Energy Agency (IEA). (2025d). *Executive summary*. In *World energy investment 2025*. IEA. https://www.iea.org/reports/world-energy-investment-2025/executive-summary

International Energy Agency (IEA). (2025e). *Financing electricity access in Africa*. https://www.iea.org/reports/financing-electricity-access-in-africa

International Energy Agency (IEA). (2025f). *State of play*. In *Financing electricity access in Africa*. IEA. https://www.iea.org/reports/financing-electricity-access-in-africa/state-of-play

International Energy Agency (IEA). (2025g). *The path to a new era for nuclear energy*. International Energy Agency. https://www.iea.org/reports/the-path-to-a-new-era-for-nuclear-energy

International Energy Agency (IEA). (2026a). *Electricity consumption by data centres, 2020-2035* [Data visualization]. IEA. https://www.iea.org/data-and-statistics/charts/electricity-consumption-by-data-centres-2020-2035

International Energy Agency (IEA). (2026b). *Electricity mid-year update 2026*. https://www.iea.org/reports/electricity-mid-year-update-2026

International Energy Agency (IEA). (2026c). *Key questions on energy and AI*. https://www.iea.org/reports/key-questions-on-energy-and-ai

International Finance Corporation (IFC). (2026). *Raxio DC (Project No. 48537): Summary of investment information*. https://disclosures.ifc.org/project-detail/SII/48537/raxio-dc

International Renewable Energy Agency (IRENA). (2025). *Renewable power generation costs in 2024*. https://www.irena.org/Publications/2025/Jun/Renewable-Power-Generation-Costs-in-2024

International Telecommunication Union (ITU) & World Bank. (2023). *Green data centers: Towards a sustainable digital transformation – A practitioner's guide*. https://www.itu.int/hub/publication/d-them-32-2023-01/

International Telecommunication Union (ITU). (2025). *Measuring digital development: Facts and figures 2025*. https://www.itu.int/itu-d/reports/statistics/facts-figures-2025/

International Telecommunication Union (ITU). (2026). *ITU presentation* [Presentation]. International Telecommunication Union. https://www.itu.int/itu-d/sites/projectumc/wp-content/uploads/sites/42/2026/01/ITU-Presentation-14-January-2026.pdf

International Telecommunication Union, & United Nations Institute for Training and Research. (2024). *The global e-waste monitor 2024*. https://www.itu.int/en/ITU-D/Environment/Pages/Publications/The-Global-E-Waste-Monitor-2024.aspx

Jayaram, K., Bennici, L., Tsimba, N., von Schantz, S., & Soliman, S. (2025). *Building data centers for Africa's unique market dynamics*. McKinsey & Company. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/building-data-centers-for-africas-unique-market-dynamics

Knight Frank. (2025). *Data centres global report 2025*. https://content.knightfrank.com/research/2982/documents/en/data-centres-global-report-2025-12054.pdf

Kojima, M., & Trimble, C. (2016). *Making power affordable for Africa and viable for its utilities*. World Bank. https://doi.org/10.1596/25091

Kuyoro, M., Bagus, U., Bensrhir, A., & Bobat, Z. (2025). *Leading, not lagging: Africa's gen AI opportunity*. McKinsey & Company (QuantumBlack). https://www.mckinsey.com/capabilities/quantumblack/our-insights/leading-not-lagging-africas-gen-ai-opportunity

Kuzma, S., Saccoccia, L., & Chertock, M. (2023). *25 countries, housing one-quarter of the population, face extremely high water stress*. World Resources Institute. https://www.wri.org/insights/highest-water-stressed-countries

Liou, J. (2023). *What are small modular reactors (SMRs)?* International Atomic Energy Agency (IAEA). https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs

Matthews, O. (2026). *Data Centres: New Real Estate Asset Class of Choice* in *The Africa report 2026/27*. Knight Frank. https://www.knightfrank.com/content-assets/f9012b7bd3784465a422696389146099/africa-report-2026-27.pdf

Médias24. (2026). *Électricité : après trois ans d'attente, le Maroc débloque enfin l'autoproduction*. 18 March. https://medias24.com/2026/03/18/electricite-apres-trois-ans-dattente-le-maroc-debloque-enfin-lautoproduction-1645705/

Minges, M. (2024). *Digital infrastructure: The continual need for upgrading and greening*. In *Digital progress and trends report 2023* (Chap. 3, pp. 45–64). World Bank. https://doi.org/10.1596/978-1-4648-2049-6

Mondaq. (2025). *The Electricity Act 2023: the centralisation of power and the rise of state electricity markets*. https://www.mondaq.com/nigeria/renewables/1787744/

Mordor Intelligence. (2025). *Africa data center market: Growth, trends, and forecast*. Mordor Intelligence. https://www.mordorintelligence.com/industry-reports/africa-data-center-market

National Energy Regulator of South Africa (NERS). (2025). *Regulatory rules on network charges for third-party wheeling of energy (Version 01, Government Gazette No. 52781, Notice No. 6263)*. Department of Mineral Resources and Energy. https://www.gov.za/sites/default/files/gcis_document/202506/52781gon6263.pdf

National Treasury of South Africa. (2026). *Media statement: Independent Transmission Projects (ITP) Programme and next phase of procurement*. 1 October. Pretoria.

NEC Networks & System Integration Corporation (NESIC). (2025). *[Title as listed in PDF]*. https://www.nesic.co.jp/english/news/fomr2i00000015jm-att/fomr2i00000018ga.pdf

Net Zero Insights. (n.d.). *Innovation pathways: Sustainable data centers*. Net Zero Insights. https://netzeroinsights.com/resources/innovation-pathways-sustainable-data-centers/

Nuclear Energy Agency (NEA). (2026). *Release of the NEA Small Modular Reactor Digital Dashboard: Fourth Edition*. OECD Nuclear Energy Agency. https://www.oecd-nea.org/jcms/pl_122015/release-of-the-nea-small-modular-reactor-digital-dashboard-fourth-edition

Nwankwo, J. E. (2025). Redefining competition and submarine cable ownership: Equiano, MainOne, and the making of middlemen. *The Information Society, 41*(5), 279–289. https://doi.org/10.1080/01972243.2025.2547676

Operand. (n.d.). *Data centre infrastructure capacity thesis*. https://www.operand.com/resources/data-centre-infrastructure-capacity-thesis

Organisation for Economic Co-operation and Development (OECD). (2019). *Enhancing access to and sharing of data: Reconciling risks and benefits for data re-use across societies*. OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2019/11/enhancing-access-to-and-sharing-of-data_070835df/276aaca8-en.pdf

Republic of Kenya. (2024). *The Energy (Electricity Market, Bulk Supply and Open Access) Regulations, 2024*. Gazette Notice 2512 of 2024. https://new.kenyalaw.org/akn/ke/act/gn/2024/2512/eng@2024-03-01

Republic of South Africa. (2024). *Reforms in licensing for embedded generation*. Operation Vulindlela. https://www.stateofthenation.gov.za/assets/downloads/ov-conf/reforms-in-licensing-for-embedded-generation-1725624025.pdf

Research and Markets. (2025). *Africa data center market landscape 2025–2030*. https://www.researchandmarkets.com/r/3t9ppp

Rollinson, W., Urquhart, A., & Thomson, M. (2025). Technoeconomic feasibility of wind and solar generation for off-grid hyperscale data centres. *Energies, 18*(2), Article 382. https://doi.org/10.3390/en18020382

Shumba, Noah, Opelo Tshekiso, Pengfei Li, Giulia Fanti and Shaolei Ren. (2024). *A water efficiency dataset for African data centers*. arXiv:2412.03716. https://arxiv.org/abs/2412.03716

SolaX Power. (2025). *Key points about grid-connected renewable energy systems*. https://nl.solaxpower.com/blogs/key-points-about-grid-connected-renewable-energy-systems.html

Solis, B. (2025). *Defying outages: The struggles and strategies of businesses facing unreliable electricity* (Global Indicators Briefs No. 32). World Bank. https://documents1.worldbank.org/curated/en/099859206252515733/pdf/IDU-3c6e1629-8a38-4e33-8229-59a9ba43209b.pdf

Solomon, S. (2024). *Sustainable by design: Next-generation datacenters consume zero water for cooling*. Microsoft. https://www.microsoft.com/en-us/microsoft-cloud/blog/2024/12/09/sustainable-by-design-next-generation-datacenters-consume-zero-water-for-cooling/

SSCG Group. (n.d.). *AI economic potential and data centre infrastructure in Africa*. SSCG Group. https://sscg-group.com/product-development/f/ai-economic-potential-and-data-centre-infrastructure-in-africa?blogcategory=Africa

Sustainable Energy for All (SEforALL). (2025). *Assessing grids in Africa: Supporting data-driven decision making to drive implementation of the COP29 global energy storage and grids pledge*. https://www.unescap.org/sites/default/d8files/event-documents/Assessing%20Grids%20in%20Africa%20by%20SEforALL.pdf

Synergy Research Group. (2025). *Hyperscale data center count hits 1,136; average size increases; US accounts for 54% of total capacity*. https://www.srgresearch.com/articles/hyperscale-data-center-count-hits-1136-average-size-increases-us-accounts-for-54-of-total-capacity

Synergy Research Group. (2026). *Hyperscale operators to account for 67% of all data center capacity by 2031*. https://www.srgresearch.com/articles/hyperscale-operators-to-account-for-67-of-all-data-center-capacity-by-2031

Technical University of Denmark (DTU). (n.d.). *COOL-DATA: Sustainable data centre solutions*. https://cool-data.dtu.dk/

Teraco. (2024). *Teraco commences construction on 120MW utility-scale solar power plant*. https://www.itweb.co.za/article/teraco-commences-construction-on-120mw-utility-scale-solar-power-plant/Pero3qZ3dgpvQb6m

Teraco. (2025). *Teraco completes CT2 data centre expansion, increasing Cape Town's hyperscale capacity to 50 MW*. https://www.teraco.co.za/news/teraco-completes-ct2-data-centre-expansion/

Teraco Data Environments. (2026). *Africa's data centres and cloud infrastructure growth, connectivity and digital transformation*. Teraco Data Environments. https://www.teraco.co.za/blog/africas-data-centres-and-cloud-infrastructure-growth-connectivity-and-digital-transformation/

TheCable. (2025). *Digital independence: Reclaiming Africa's tech sovereignty in a data-colonised world*. https://www.thecable.ng/digital-independence-reclaiming-africas-tech-sovereignty-in-a-data-colonised-world/

The Green Grid. (2011). *Water usage effectiveness (WUE™): A Green Grid data center sustainability metric (White Paper No. 35)*. https://www.thegreengrid.org/system/files/store/WUE_v1.pdf

ThinkGeoEnergy. (2026). *Kenya suspends plans for Microsoft's geothermal-powered data centre*. May. https://www.thinkgeoenergy.com/kenya-suspends-plans-for-microsofts-geothermal-powered-data-centre/

TimesLive. (2025). *World Bank backs Africa digital data push with $100m Raxio deal*. 3 April. https://www.timeslive.co.za/news/sci-tech/2025-04-03-world-bank-backs-africa-digital-data-push-with-100m-raxio-deal/

Timilsina, G. R. (2025). *What underlies the poor financial performance of electric utilities in Sub-Saharan Africa? (World Bank Policy Research Working Paper No. 11257)*. World Bank. https://documents1.worldbank.org/curated/en/099912211102516982/pdf/IDU-8c8b805d-8bc2-47fe-853c-65967651a3a6.pdf

Ubergizmo. (2026). *Microsoft's Kenya AI data center*. 16 May. https://www.ubergizmo.com/2026-05/microsofts-kenya-ai-data-center/

United Nations Conference on Trade and Development (UNCTAD). (2026). *Global investment trends monitor No. 50*. UNCTAD. https://unctad.org/publication/global-investment-trends-monitor-no-50

United Nations, Department of Economic and Social Affairs (UN DESA), Population Division. (2024). *World population prospects 2024*. United Nations. https://population.un.org/wpp/

United Nations Economic Commission for Africa (UNECA). (2024). *Digital Infrastructure in Africa*. Addis Ababa. https://www.uneca.org/digital-infrastructure-in-africa

United Nations Economic Commission for Africa (UNECA). (2026). *Economic report on Africa 2026: Growth through innovation: Harnessing data and frontier technologies for Africa's economic transformation*. https://uneca.org/economic-report-on-africa-2026

UN Trade and Development. (2024). *Digital economy report 2024: Shaping an environmentally sustainable and inclusive digital future*. https://unctad.org/publication/digital-economy-report-2024

UN Trade and Development. (2025). *World investment report 2025: International investment in the digital economy*. https://unctad.org/publication/world-investment-report-2025

Uptime Institute. (n.d.). *Tier standard: Topology*. https://uptimeinstitute.com/tiers

Uptime Institute. (2025). *Uptime Institute Global Data Center Survey 2025*. New York. https://intelligence.uptimeinstitute.com/resource/uptime-institute-global-data-center-survey-2025

Uptime Institute. (2026). *Global data center survey 2026*. Uptime Institute. https://datacenter.uptimeinstitute.com/rs/711-RIA-145/images/UptimeInstitute.GlobalDataCenterSurvey.2026.pdf

U.S. Department of Energy (DOE). (n.d.-a). *Cooling water efficiency opportunities for federal data centers*. Federal Energy Management Program. https://www.energy.gov/cmei/femp/cooling-water-efficiency-opportunities-federal-data-centers

U.S. Department of Energy (DOE). (n.d.-b). *Geothermal and data centers*. https://www.energy.gov/hgeo/geothermal/geothermal-and-data-centers

U.S. Environmental Protection Agency (EPA). (2023). *Water reuse case study: Quincy, Washington*. https://www.epa.gov/waterreuse/water-reuse-case-study-quincy-washington

Van Geet, O., & Sickinger, D. (2024). *Best practices guide for energy-efficient data center design (Revised July 2024)*. Federal Energy Management Program, U.S. Department of Energy. https://www.energy.gov/sites/default/files/2024-07/best-practice-guide-data-center-design.pdf

Vanham, D. (2026). *Africa's power plants are set for expansion by 2030, with renewables' share growing from 19% to 34%*. International Water Management Institute (IWMI). https://www.iwmi.org/blogs/africas-power-plants-are-set-for-expansion-by-2030-with-renewables-share-growing-from-19-to-34/

WIOCC. (n.d.). *Core networks*. WIOCC Group. https://www.wiocc.net/core-networks

World Bank. (n.d.). *Electric power transmission and distribution losses (% of output) (EG.ELC.LOSS.ZS)*. World Bank Data. Retrieved October 21, 2026, from . https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=ZG

World Bank. (2012). *Project appraisal document: Eastern Electricity Highway Project (Report No. 69252-AFR)*. https://documents1.worldbank.org/curated/en/620191468212087246/pdf/692520PAD0P1260Official0Use0Only090.pdf

World Bank. (2019). *Mini grids for half a billion people: Market outlook and handbook for decision makers*. https://www.worldbank.org/en/topic/energy/publication/mini-grids-for-half-a-billion-people

World Bank. (2021). *World development report 2021: Data for better lives*. https://doi.org/10.1596/978-1-4648-1607-9

World Bank. (2023). *Digital Africa: Technological transformation for jobs*. World Bank. https://www.worldbank.org/en/region/afr/publication/digital-africa

World Bank. (2024). *Water for shared prosperity*. https://www.worldbank.org/en/publication/water-for-shared-prosperity

World Bank. (2025a). *17 countries commit to concrete plans to scale up electricity access as Mission 300 expands*. Press release, 24 September. https://www.worldbank.org/en/news/press-release/2025/09/24/17-countries-commit-to-concrete-plans-to-scale-up-electricity-access-as-mission-300-expands

World Bank. (2025b). *Mobile phone technology powers saving surge in developing economies*. World Bank. https://www.worldbank.org/en/news/press-release/2025/07/16/mobile-phone-technology-powers-saving-surge-in-developing-economies

World Bank (WB), International Energy Agency (IEA), International Renewable Energy Agency (IRENA), United Nations Statistics Division (UNSD), & World Health Organization (WHO). (2026). *Access to electricity*. In *Tracking SDG 7: The energy progress report 2026* (Chap. 1, pp. 10–34). https://trackingsdg7.esmap.org/sites/default/files/download-documents/Chapter1-AccesstoElectricity.pdf

World Bank. (2026a). *Building data infrastructure for AI readiness*. World Bank. https://www.worldbank.org/en/results/2026/05/06/data-infrastructure-for-ai

World Bank. (2026b). *Connecting West Africa through regional power integration and expanded electricity access*. https://www.worldbank.org/en/results/2026/05/11/connecting-west-africa-through-regional-power-integration-and-expanded-electricity-access

World Bank and others. (2025). *Tracking SDG 7: The Energy Progress Report 2025*. Washington, D.C. https://www.worldbank.org/en/topic/energy/publication/tracking-sdg-7-the-energy-progress-report-2025

World Economic Forum. (2026). *Why does West Africa's power market moment matter now?* July. https://www.weforum.org/stories/energy-transition/why-does-west-africa-s-power-market-moment-matter-now/

Yeboua, K. (2026). *Large infrastructure: Access to electricity*. African Futures & Innovation Programme, Institute for Security Studies (ISS). https://futures.issafrica.org/thematic/11-large-infrastructure/

Yi, H., & Kim, K. N. (2025). Transforming aid-funded renewable energy systems: A case study of policy-driven financial sustainability in rural Bangladesh. *Renewable Energy, 246*, Article 122752. https://doi.org/10.1016/j.renene.2025.122752

Yu, H. J. J., & Geoffron, P. (2020). Solar PV market and policies. In *Photovoltaic solar energy conversion* (pp. 413–437). Elsevier. https://doi.org/10.1016/B978-0-12-819610-6.00013-2