SUSTAINABLE ENERGY FOR ALL

ENERGY. CLIMATE.
DEVELOPMENT.

Assessing Grids in Africa

SUPPORTING DATA-DRIVEN DECISION MAKING TO DRIVE IMPLEMENTATION OF THE COP29 GLOBAL ENERGY STORAGE AND GRIDS PLEDGE.

MAY 2025

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EXECUTIVE SUMMARY

Grid Opportunities & Challenges Across Africa.

Resilient and efficient grids

Healthy electricity grids are critical for achieving sustainable energy for all

Countries have an opportunity to provide leadership on resilient and efficient electricity grids by committing to the Global Energy Storage and Grids Pledge. Initially only 2 countries from Africa committed to the pledge at COP29, while there are now there are 7 out of the 54 countries from Africa committed to the pledge. By making more data and information available, our goal is to support more country commitments to the Pledge and support an action agenda on grids through COP30.

As energy systems evolve, strong grids will be the backbone of a decarbonized world, enabling climate resilience, energy security, and economic growth.

Future-ready grids and mini-grids must be adaptable, shock-resistant, and capable of integrating growing shares of clean energy. Modern grids must handle bi-directional, intermittent renewable flows, requiring upgrades in digitalization, storage, interconnectivity, and smart planning.

Investing in grid infrastructure is crucial to meeting the pace and scale of renewable deployment—scaling from 3,870 GW in 2023 to at least 11,000 GW by 2030. To enable these investments, this project looks to support data-driven decision making on grids and electricity system networks.

Assessing grids

Five categories can support data-driven assessments of power and transmission project status and readiness for investment.

Policy and Market Structure

- Political commitment
- Institutional structure
- Electricity markets and regulations
- Electricity capacity and generation mix
- Variable & non-synchronous assets
- Energy security & system flexibility

Grid Development Ecosystem

- Grid mix: mini-grid, distribution, transmission
- Regional interconnectors
- Grid planning and procedures
- Grid development investment ecosystem
- Timeline, tariffs, transparency risks
- Private sector participation

Grid Operations

- Institutional setting and procedures for grid's technical operation
- Grid reliability and efficiency
- Economic dispatch: grid utilization, renewable energy evacuation
- Grid digitalization

Grid Services to Consumers

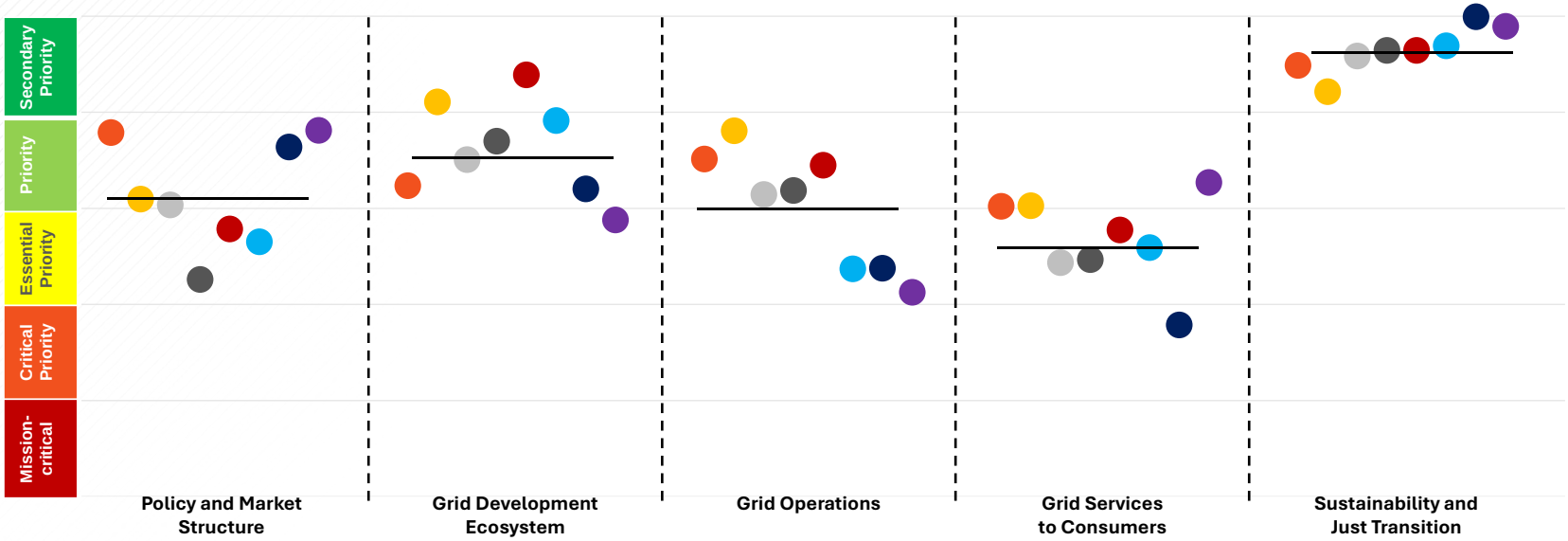
- Service quantity - provision of electricity access and consumption
- Service quality - reliability of services
- Affordability of power

Sustainability and Just Transition

- Environmental la w and regulations
- Inclusive development – public engagement
- Carbon intensity of sector

Assessing grids across 5 categories

Examining 10 countries in Africa, trends shows that grids have favorable policy environment and grid development ecosystem; however, higher priorities for action include digitized grid operations and massive grid expansion to consumers.



KEY FINDINGS

Regional and Country Grid Insights.

Common opportunities across Africa

Each country is different, but regional trends are useful to programmatic design.

Electricity Policy

Commitment to grid development varies across African countries, with few pledging to the Global Energy Storage and Grids Pledge, though all have renewable targets and most ensure equal grid access; power sector structures range from state-owned to unbundled markets, with Egypt, Kenya, and South Africa moving toward competitive markets and growing regional trade through increased interconnector capacity.

Maximizing flexibility

African countries have yet to face significant grid issues from variable renewable energy integration, benefit from power flexibility resources (gas, hydro, and growing interconnectors), have strengthened transmission grid and have started demand flexibility through time of use tariffs and demand response. Supply and demand flexibility innovation and provide cost efficiency and capacity growth opportunities.

Regional leadership and cooperation

Progress in system planning, economic regulations (tariffs and ratio setting), and technical regulations (grid codes) highlights the need for broader expertise and clear principles to support rapid power system transition, with regional cooperation through the African Union and power pools offering a foundation for efficient resource sharing, cross-border trade, and strategic environmental assessments.

Electricity Market Structure

Diverse power mixes, low consumption, and growing opportunity.

African countries in this project can be grouped into three electricity generation profiles: dominant fossil fuels (mainly gas) with hydro as a secondary source; strong clean electricity with hydro and fossil fuels (mostly natural gas); and coal-dominant (South Africa) without natural gas. The first two groups differ due to water resource availability, with Eastern Africa having better access to hydro.

Most countries, except South Africa and Egypt, have per capita electricity consumption below the Modern Energy Minimum of 1000 kWh/year, making on-grid expansion crucial for economic and social development. While reserve margins are generally high, they may deplete quickly with growing electricity access and demand, especially in countries with low firm capacity. All countries currently have small VRE shares, no renewable power plants in the connection queue, and no curtailment issues.

Grid Development Ecosystems

Uneven grid planning, rising energy grid needs, and regulatory gaps.

While many countries recognize the importance of integrated power system planning and have adopted least-cost, geospatial approaches, not all have published forward-looking plans aligned with accelerated energy transition goals or adequately assessed variable renewable energy (VRE) deployment. Renewable development zones and evacuation corridors are limited, mainly seen in Nigeria and South Africa, and some countries rely on outdated or unrealistic supply-demand projections.

Transmission capacity is generally sufficient except in Nigeria, and while interconnector expansion efforts are underway, asset age and lack of data constrain modernization and VRE integration. Regulatory frameworks and private-sector participation exist across countries, but inconsistencies in tariff-setting, cost allocation, and institutional capacity hinder investment effectiveness and the realization of system planning objectives.

Grid Operations

Transmission rules evolving, but gaps remain in pricing, codes, digitalization.

Many countries have rules for transmission cost allocation and rate setting, but methodologies and clarity vary, affecting cost-reflectiveness and private sector confidence, while wheeling charges are generally non-discriminatory, though not always transparently published—especially in vertically integrated systems. Power trade via interconnectors would benefit from clearer operational charge rules, and most grid losses originate from distribution systems, highlighting the need to reduce both technical and commercial losses.

Grid codes often include provisions for VRE and non-synchronous generators, but their scope and detail differ, with some needing updates to address VRE-specific requirements, resource adequacy, and flexibility. Real-time dispatch, VRE forecasting, and competitive procurement of ancillary services are limited, and low digitalization readiness hampers advanced market operations, underlining the need for improved grid code design and digital infrastructure.

Grid Services to Consumers

Access gaps persist; affordability, grid expansion, and scale are critical

Among the assessed countries, only Egypt has achieved universal electricity access, with urban areas generally well-served, but rural access remains low in several countries, making grid expansion essential. Most countries have low per capita electricity consumption relative to the Modern Energy Minimum target, and while off-grid technologies are important for access, they alone cannot support higher consumption without complementary grid development.

Electricity service quality is monitored through standards like SAIFI and SAIDI, and although residential tariffs are generally affordable, some low-access countries face high tariffs that burden vulnerable populations, despite financial support mechanisms. Achieving cost reductions and broader access requires coordinated efforts in system planning, regulatory reform, business model innovation, financing, and demand stimulation, as well as improving the affordability and effectiveness of connection fees and support schemes.

Sustainability and Just Transition

Strong ESIA frameworks in place; SEA implementation needs strengthening.

All assessed countries have strong environmental and social impact assessment (ESIA) frameworks for transmission and interconnector projects, often aligned with international standards and driven by donor requirements, with robust implementation, public consultation, and compensation practices. Most also have stakeholder engagement and resettlement planning processes in place.

While many countries have strategic environmental assessment (SEA) frameworks for broader grid planning, implementation is inconsistent, and greater transparency, stakeholder involvement, and public disclosure are needed. Strengthening SEA can support renewable energy development by reducing project-level ESIA burdens, and while some countries maintain relatively low carbon intensity due to significant hydropower in their energy mix, some countries still have higher carbon intensity from fossil fuel power generation.

KEY INDICATORS

Regional and Country Grid Data and Information.

Electricity grid policy and market structure

	Global High/Low	Egypt	Ethiopia	Ghana	Kenya	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia
Power system size (MW, 2022)	N/A	59,301	5,734	5,519	3,747	12,036 (2020)	295	65,871	1,818	1,450	3,948
RE share in power mix (2022)	97.7% DRC / 2.7% Algeria	10.5%	91.5%	30.5%	42.2%	65.4%	50.2%	15.5%	32.5%	77.4%	82.6%
VRE share in power mix (2022)	58.4% Netherlands / near 0%	5.7%	7.4%	1.8%	19.8%	3.1%	8.6%	14.1%	1.0%	6.5%	2.4%
Annual average growth of VRE installed capacity (over 5 years, 2017-2022)	295.3% Zambia / -7.6% Dominica	29.2%	4.8%	-8.9%	59.2%	14.1%	8.5%	11.3%	5.9%	16.2%	295.3%
Average annual growth in electricity demand (over 5 years, 2017-2022)	37.5% Bhutan / -14.0% Lebanon	1.7%	3.9%	8.8%	1.1%	3.6%	9.4%	-2.0%	5.6%	10.3%	3.5%
System flexibility (sub-indicator of WEF ETI, 0-100)	100 Gabon / 1.1 Mongolia	95.5	95.6	99.7	84.0	98.1	N/A	3.2	99.3	N/A	94.2
Demand projection (2030)	N/A	N/A	N/A	5479 MW (peak)	3320 MW	192 TWh (IRENA)	397 MW (peak)	34-5 GW	4878 MW (peak)	1644 MW	5422 MW (peak)
Generation supply target (2030)	N/A	N/A	17500 MW	7606 MW	4689 MW (3650 MW firm capacity)	56 GW (total) 43 GW (on-grid) (IRENA)	547-562 MW	90.9 GW	6390 MW	2300MW	10013 MW
Grid target / strategy in national policy / planning or NDC	Yes / No	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Independent regulatory body	Yes / No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: RE renewable energy; VRE variable renewable energy; RE share in power mix high and low are high and low for Africa only.
Data sources: US EIA; WEF; National documents of respective countries (See each country profile and Appendix 2 in the full report)

Electricity grid development ecosystem

	Global High/Low	Egypt	Ethiopia	Ghana	Kenya	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia
Transmission circuit length (km, 2022)	N/A	54507 km	21397 km	6472 km	8739 km	8229 MW	1158 km (June 2023)	33 194 km	6139 km	N/A	N/A
Transformer capacity (MVA, 2022)	N/A	199517 MVA	N/A	9642 MVA	5455 MVA	N/A	N/A	155 820 MVA (March 2023)	6519 MVA	6445.5 MVA	10407 MVA
Annual average growth ratio of transmission line length (over 5 years)	N/A	3.3% (2019-2024)	4.2% (2017-2022)	2.2% (2018-2023)	4.6% (2019-2024)	N/A	7.0% (3 years, 2021-2024)	0.32% (2019-2024)	6.4% (2019-2024)	N/A	9.6% (one year, 2022-2023)
VRE in transmission connection queue (MW)	N/A	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Current interconnections capacity (MW, known)	15965 Germany / 0 many countries	840	6000	438	2145	872	257 (?)	7180	100	2400 (?)	2090
Distribution Transformer capacity (MVA)	N/A	100344 MVA (June 2023)	N/A	N/A	15149 MVA (FY 2023/24)	N/A	N/A	146927 MVA (2024)	N/A	N/A	N/A
Distribution overhead and cable length (km)	N/A	578588 km (June 2023)	N/A	N/A	310312 km (FY2023/24)	N/A	29504 km (2023)	375760 km (2024)	163804 km (2023)	70565 km (2024)	12500 km (2022)
Annual average growth in distribution line length (over 5 years)	N/A	2.6%	N/A	N/A	6.4%	N/A	3.9%	1.2%	9.6%	6.0%	N/A
Economic regulations - grid tariff determination / its cost reflectiveness (Y/N)	Yes/Yes / No/No	Yes / Yes	Yes / No	Yes / Yes	No / No	Yes / Yes	Yes / Yes	Yes / Yes	Yes / Yes	No / No	Yes / Yes
Private participation / investment in transmission asset development (Y/N)	Yes / No	Yes (limited with EPC)	Yes (limited with EPC & consultancy)	Yes (limited with EPC)	Yes (with multiple biz models)	Yes (limited with EPC but changes in progress)	Yes (with multiple biz models)	Yes (limited with EPC but changes in progress)	Yes (limited with EPC but changes in progress)	Yes (with EPC and IPT models)	Yes

Note: RE renewable energy; VRE variable renewable energy; EPC Engineering, Procurement & Construction; IPT Independent Power Transmission.
Data sources: US EIA; National documents of respective countries (See each country profile and Appendix 2 in the full report)

Electricity grid operations

	Global High/Low	Egypt	Ethiopia	Ghana	Kenya	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia
Transmission grid loss (total, %, 2022)	86.4% Palestine / 0.3% Cayman Isl.	17.9%	18.1%	29.3%	22.7%	14.2%	13.6%	11.0%	12.9%	19.2%	10.3%
Distribution grid loss (% of power generation)	N/A	22.5% (2021)	N/A	30.0% (2022)	18.0% (2023)	25.0% (2022)	N/A	9.7% (2023)	N/A	17.6% (2022)	N/A
RE curtailment ratio in transmission (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RE Priority dispatch (Y/N)	Yes / No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No

Note: RE renewable energy.
Data sources: US EIA; National documents of respective countries (See each country profile and Appendix 2 in the full report)

Electricity grid services to consumers

	Global High/Low	Egypt	Ethiopia	Ghana	Kenya	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia
Electricity access (2022)	100% many / 5.4% South Sudan	100%	55.4%	85.1%	76.0%	60.5%	50.6%	86.5%	45.8%	47.1%	47.8%
SAIFI (2023)	81.65 Pakistan / 0.02 Japan	3	N/A	36.3	6.9	N/A	21.7 (2022-23)	6.0	46.8	N/A	4.9
SAIDI (2023)	243.6 Zimbabwe / 0.04 Japan	2.0	N/A	55.9	12.0	N/A	N/A	30.5	20.9	N/A	51.2
Electricity consumption per capita (kWh/yr/capita, 2022)	50,512.9 Iceland / 14.2 Sierra Leone	1592.2	85.9	571.8	178.1	144.5	62.5	3348.7	121.1	84.0	747.7
Average residential tariff (USD/kWh)	0.704 Jamaica / 0.002 Cote d'Ivoire	0.048	0.039	0.138	0.102	0.91	0.215	0.154	0.081	0.217	0.054
Consumer tariff subsidy / pricing support (Y/N)	Yes / No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Note: SAIFI System Average Interruption Frequency Index; SAIDI System Average Interruption Duration Index.
Data sources: US EIA; WEF; National documents of respective countries (See each country profile and Appendix 2 in the full report)

Electricity grid sustainability and just transition

	Global High/Low	Egypt	Ethiopia	Ghana	Kenya	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia
ESIA process for transmission projects (Y/N)	Yes / No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Established public consultation / compensation framework and procedure (Y/N)	Yes / No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Carbon intensity of power sector (g CO2eq/Wh/yr)	8373 Montenegro / 0 Many	426.6	0.24	331.2	88.1	319.9	319.4	882.16	277.4	7.3	96.8

Note: ESIA environmental and social impact assessment.
Data sources: US EIA; National documents of respective countries (See each country profile and Appendix 2 in the full report)

Availability of data by category and country

	Egypt	Ethiopia	Ghana	Kenya	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia
1. Electricity grid policy and market structure	8/10 80%	9/10 90%	10/10 100%	10/10 100%	10/10 100%	9/10 90%	10/10 100%	10/10 100%	9/10 90%	10/10 100%
2. Electricity grid development ecosystem	9/10 90%	6/10 60%	6/10 60%	9/10 90%	4/10 40%	7/10 70%	9/10 90%	9/10 90%	6/10 60%	6/10 60%
3. Electricity grid operations	3/4 75%	2/4 50%	3/4 75%	3/4 75%	3/4 75%	2/4 50%	3/4 75%	2/4 50%	3/4 75%	2/4 50%
4. Electricity grid services to consumers	6/6 100%	4/6 67%	6/6 100%	6/6 100%	4/6 67%	5/6 83%	6/6 100%	6/6 100%	4/6 67%	6/6 100%
5. Electricity grid sustainability and just transition	3/3 100%	3/3 100%	3/3 100%	3/3 100%	3/3 100%	3/3 100%	3/3 100%	3/3 100%	3/3 100%	3/3 100%
Total by country	**29/33 88%**	**24/33 73%**	**28/33 85%**	**28/33 85%**	**24/33 73%**	**26/33 79%**	**31/33 94%**	**30/33 91%**	**25/33 76%**	**27/33 82%**

Note: Further data may be available in country data and information repositories but were not discovered during this pilot project.

Sustainable Energy for All (SEforALL) is an independent international organization that works in partnership with the United Nations and leaders in government, the private sector, financial institutions, civil society and philanthropies to drive faster action on Sustainable Development Goal 7 (SDG7) – access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement on climate change.

SEforALL works to ensure a clean energy transition that leaves no one behind and brings new opportunities for everyone to fulfil their potential.

SEforALL.org