THE AFRICAN CLIMATE FOUNDATION

ENERGY DATA CHALLENGES IN AFRICA'S ELECTRICITY LANDSCAPE

THE BIG PICTURE

Universal access to affordable, sustainable and clean energy remains a challenge, especially in Africa. In 2019, some 759 million people still did not have access to electricity – 570 million (75%) in sub-Saharan Africa – and at the rate of progress as of 2021, the world was not on track to meet Sustainable Development Goal (SDG) 7[1] by 2030 (IEA et al., 2021). Nevertheless, the International Energy Agency (IEA) projects electricity generation in Africa to grow three- to four-fold above 2020 levels by 2050 (IEA, 2021a).

In the context of an urgent need to reduce and eliminate unabated carbon emissions, Africa has a unique opportunity to leapfrog fossil-fuelled development in favour of policy and development based on renewable energy, with recent analysis showing that this could greatly enhance regional economic growth and job creation (IRENA & AfDB, 2022). This is despite the continent having the least historic and current responsibility for anthropogenic greenhouse gas emissions.

1 SDG 7 aims to ensure access to affordable, reliable, sustainable and modern energy for all.

THE IMPORTANCE OF ENERGY DATA

Reliable and robust data, enabling evidence-based research, policy and decision-making, including investments, is essential in enabling nations to achieve just energy transitions. IRENA notes that 'the ability to translate key energy data into robust energy planning enables countries to develop comprehensive national energy master plans and to continually update these as the basis for sound policies and investments' (KfW, GIZ, & IRENA, 2021: 60). Timely, reliable and publicly available data will be critical for informing and tracking Africa's energy transition, in supporting efforts to ensure that projected electricity demand growth is supplied by clean sources, while reducing reliance on fossil fuels altogether.

This brief discusses the availability and accessibility of electricity data for countries in Africa, from both national and global aggregated data sources. This draws on the *African Electricity Data Transparency* research recently published by the Ember Climate Group (Cunliffe & Tunbridge, 2022), as well as the initial development of the African Climate Foundation's (ACF's) African electricity database.

NATIONAL SOURCES FOR AFRICAN ELECTRICITY DATA ARE LIMITED

Ember's report[2] provides country-by-country profiles, references and evaluations of national electricity (generation) data sources, where such sources were available and could be found publicly. The research showed that, while electricity data from local national sources is available in many countries, the consistency of availability and level of detail are generally low, for example:

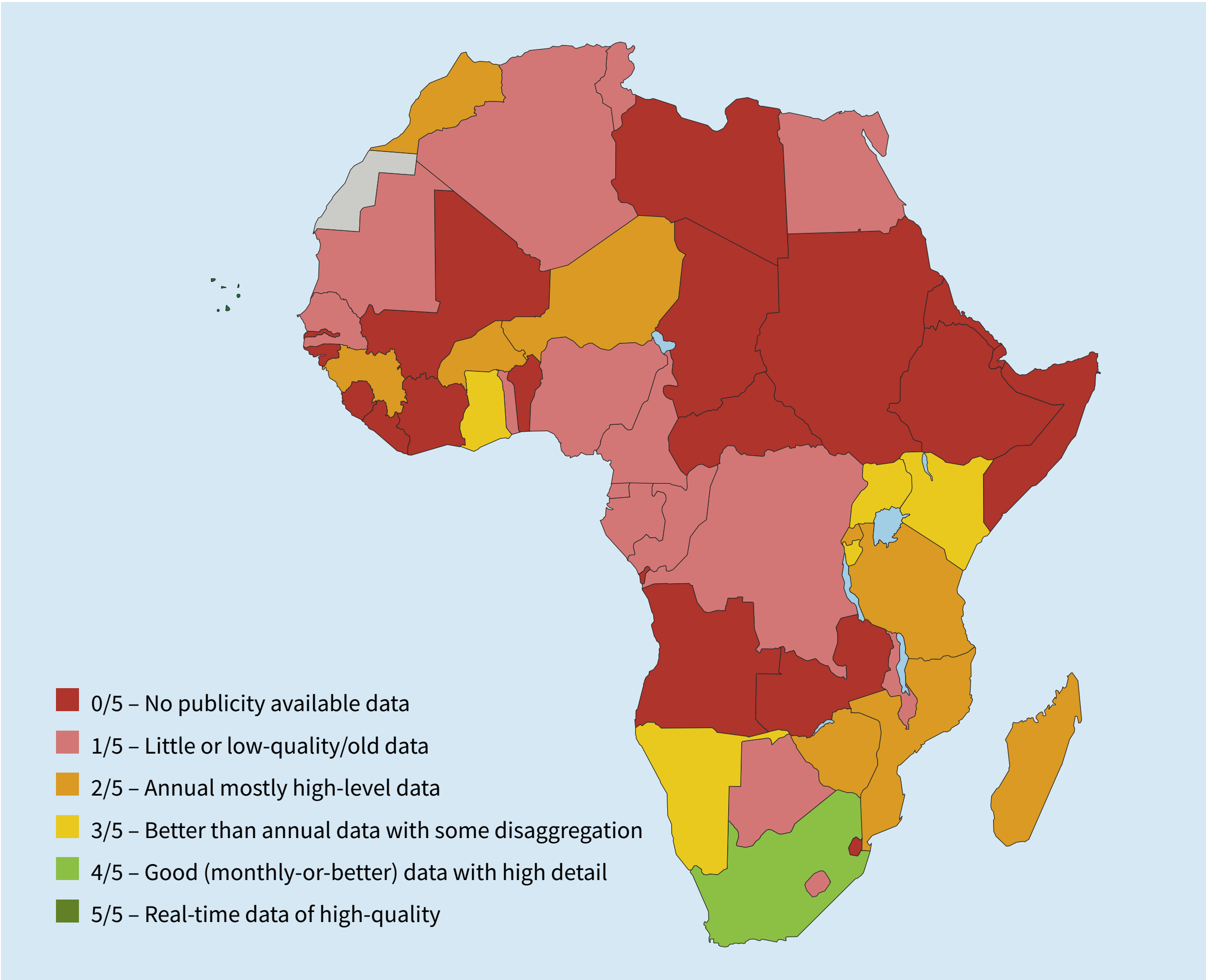
- Long lag times;
- Inconsistent publishing frequency;
- Inconsistent or limited fuel disaggregation; and
- Limited additional data categories (e.g. net imports, transmission losses, consumption, etc.).

For example, South Africa was the only country found to have near-real-time electricity supply and demand data publicly available, accessible through national utility Eskom's online data portal.[3] For most other countries where data could be found, data was typically published in annual or sub-annual reports, with varying publication lag and varying levels of detail, clarity and reliability.

Where data sources were available, these were typically provided by national statistics bureaus. For example, the Kenyan National Bureau of Statistics publishes monthly local electricity generation data by source, and monthly electricity imports and exports, in their monthly *Leading Economic Indicators* publications.[4] The availability of such data could, for example, demonstrate the need for greater focus and investment in clean energy sources.

2 See https://ember-climate.org/project/africa-electricity-data/
3 See https://www.eskom.co.za/dataportal/
4 The most recent publication, at the time of writing, was for November 2021 (https://www.knbs.or.ke/download/leading-economic-indicators-november-2021/)

Figure 1: Availability of national electricity data for African countries



Source: Cunliffe & Tunbridge, 2022

More than 40% of countries either had only outdated national data available or none at all. This may reflect the low levels of grid-based electrification in these countries, with much of their populations relying on low-level (Tier 1[5]) distributed electricity access supply (or simply not having access at all). The measure and definition of energy access, therefore, has a bearing on the technologies used and on how 'access' is understood.

Electricity data gaps are expounded in many countries by limited institutional capacity, weak or absent regulatory and reporting frameworks, and nascent large-scale ICT infrastructure – all of which make it difficult to routinely and systematically capture and report electricity supply and other key metrics. And, in some cases, this data may also be withheld for security or other undisclosed reasons.

5 See ESMAP's work on the Multi-Tier Framework (MTF) for energy access, which characterises different levels (tiers 1-5) of electricity (and clean cooking) access based on availability, reliability, affordability and other metrics. Tier 1, implying daily household usage of ≤ 12 Watt hours (Wh), is the lowest tier considered as 'with access to electricity' (ESMAP & SEforAll, 2015)

COMPARING NATIONAL AND GLOBAL AGGREGATE ELECTRICITY DATA

The electricity database developed for the ACF includes data collected and reviewed for nine African countries (Ethiopia, Kenya, Morocco, Mozambique, Namibia, Nigeria, Rwanda, Senegal and South Africa) for metrics including electricity access, historic generation mix and future projected generation mix. Data was gathered from global aggregate sources – specifically IEA, the World Bank and Ember – and national sources where available, as shown below.

Figure 2: Available data collected for the ACF electricity database

Countries	Access (World Bank)	Historic Mix up to 2019 (Ember)	2020 Mix (IEA or national)	Projections (IEA-STEPS[6])	Projections (National)
Ethiopia	✓	✓		✓	
Kenya	✓	✓	✓	✓	✓
Morocco	✓	✓	✓		
Mozambique	✓	✓		✓	✓
Namibia	✓	✓	✓		✓
Nigeria	✓	✓		✓	
Rwanda	✓	✓	✓		✓
Senegal	✓	✓		✓	
South Africa	✓	✓	✓	✓	✓

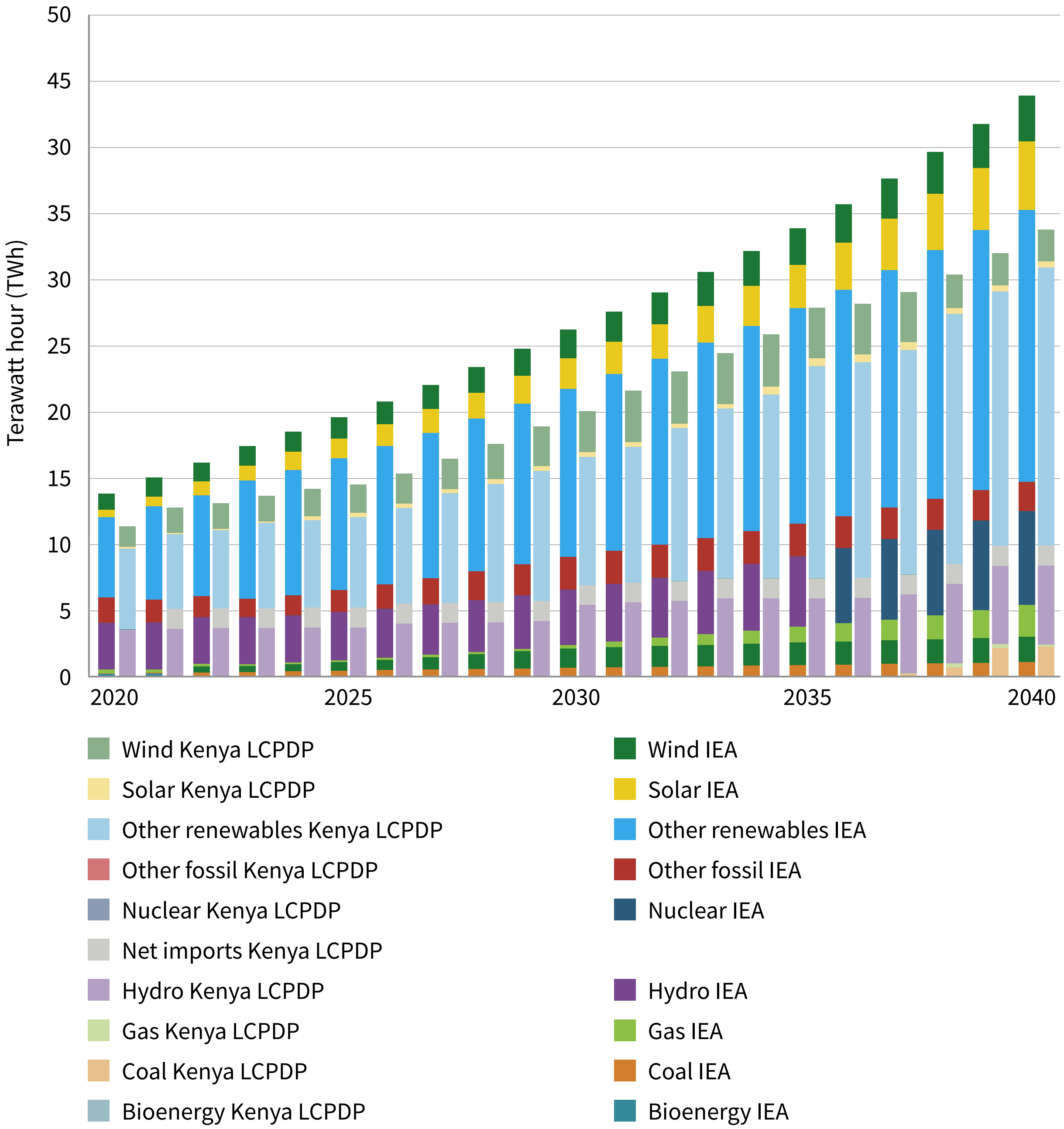
Source: author, from various sources

6 STEPS refers to the IEA's Stated Policies Scenario applied in its energy modelling (IEA, 2019), based on IEA's assessment of countries' existing policies and measures as well as those that are under development, without necessarily assuming that governments will reach all their announced goals (IEA, 2021)

Notably, the IEA-STEPS (Stated Policies Scenario) projections for countries' future electricity supply were collected from the IEA's *Africa Energy Outlook*, which was published as a standalone component of the World Energy Outlook in 2019. The timing is important to consider for two reasons:

1. Africa's electricity generation decreased in 2020, and is likely to have remained slightly reduced in 2021 due to the COVID-19 pandemic.
2. IEA's assessment of stated policies is likely to have evolved since 2019, particularly in view of its more recent net zero analysis (IEA, 2021b).

Figure 3: Comparison of IEA-STEPS and Kenya Least-Cost Power Development Plan (LCPDP) (Kenya, 2020) projections for Kenya's future electricity mix

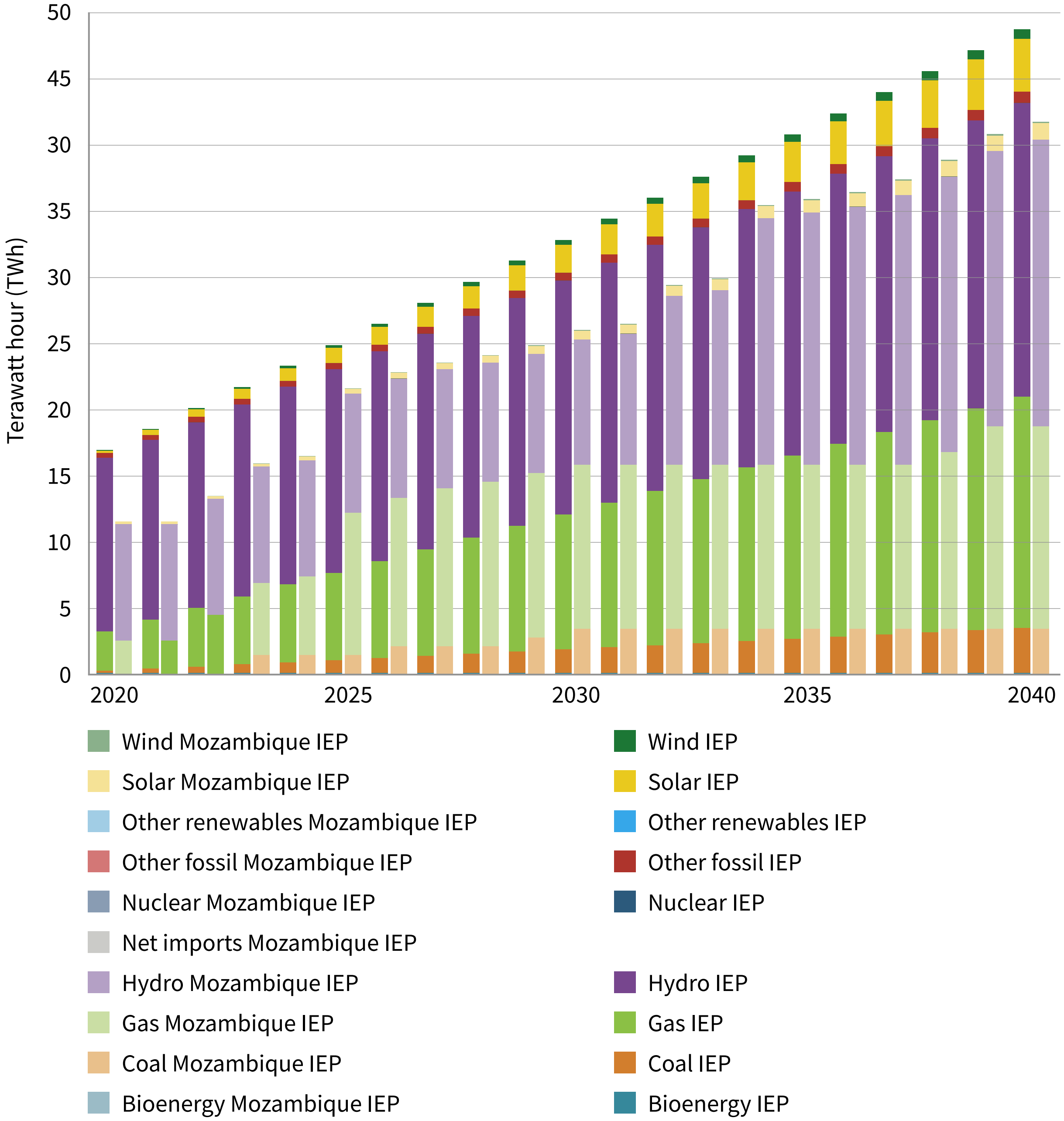


Source: Kenya Least Cost Power Development Plan 2020–2040 and International Energy Agency (2019) – Africa Energy Outlook

This may explain, in part, some of the significant differences that occur between IEA modelling and national modelling. In the cases of Kenya (Figure 3) and Mozambique (Figure 4), the IEA shows a higher projection of electricity generation, and a higher proportion of fossil fuels in the mix, compared to national modelling.

Differences between IEA and national modelling results can likely also be attributed to a difference in the underlying input data and assumptions – for example, in fuel costs, carbon constraints, electrification and other variables that influence modelling results. There may also be differences in the modelling methods utilised by the different stakeholders. Previous research found that upon reviewing electricity modelling

Figure 4: Comparison of IEA STEPS and Mozambique Integrated Energy Plan (IEP) (Electricidade de Moçambique, 2019) projections for Mozambique's future electricity mix



Source: Mozambique Integrated Energy Plan (IEP) (Electricidade de Moçambique, 2019) and International Energy Agency (2019) – Africa Energy Outlook approaches for 49 Sub-Saharan African countries, model simulations and single-criteria optimisations were the most common approaches, with comparatively few (albeit increasing) approaches using more multi-criteria decision-making optimisation algorithms (Trotter, McManus & Maconachie, 2017).

From the perspective of supporting countries' efforts to develop their energy infrastructure in concert with addressing climate change, it is strategic to engage with locally or nationally sourced and curated data to gain insight into policymakers' evidence base and understanding of the current situation and future scenarios. Where significant discrepancies occur between national and globally aggregated data, these can provide points for further interrogation and opportunities for improving the rigour of domestic data practices. Alternatively, this may also reflect inaccurate assumptions or understanding from the international source.

OTHER GAPS – INTERCONNECTION AND GOING BEYOND THE GRID

The analysis here focused on grid-based electricity generation data. However, there is additional need for focus on data on the growing distributed electricity sector throughout Africa (e.g. through off-grid and isolated mini-grid systems), as well as on the capacity and potential scale-up of national and regional transmission connectivity, as both are expected to play a critical role in Africa's electricity transition. At the regional level, this will be significant for leveraging existing power pools and regional cooperation to attract the necessary infrastructure investments and enhance cross-border electricity trade. This, in turn, could support the continent's industrialisation agenda.

The African Development Bank (AfDB), for example, views the expansion and upgrading of transmission networks as a core part of its *Light Up and Power Africa* programme, which has a highly ambitious goal of achieving universal access to energy by 2025 (AfDB, 2020). Improved regional interconnection has the potential to accelerate Africa's energy transition by providing countries with access to regional renewable electricity supply at lower costs – and this formed the principal objective of the West-African Power Pool's Master Plan in 2018 (ECOWAS, 2018). However, existing data and reporting of regional interconnections provided by the Power Pools is presently limited, and most transmission and electricity trade data can only be found in annual or operational reporting by national utilities within individual countries.

Similarly, scaling up distributed renewable energy supply, through establishing an investment-friendly policy environment supported by clear regulations and standards, is seen as one of the foremost ways to rapidly increase electricity access in Africa, particularly in rural areas (IEA et al., 2021; UCL & Bboxx, 2021). Improved and more rigorous data availability for off-grid and mini-grid projects, including around costs and performance, would contribute to de-risking these technologies, and, in turn, encourage greater investment from commercial and private funders.

Other areas where African data transparency is limited include detailed disaggregation on energy consumption by sector (eg. residential, industrial, agricultural, etc.) and further by end use (e.g. heating, cooling, lighting, etc.), as well as energy efficiency, including transmission and distribution losses. Developing, updating and publishing national energy balances, even at annual granularity, would provide coverage of energy consumption data, as well as losses throughout the system. The *African Electricity Data Transparency* report found that only four countries – Algeria, Gabon, Mauritius and South Africa – had publicly available national energy balance data, with only Mauritius publishing data for 2020 or later.

KEY TAKEAWAYS

Timely, reliable and publicly disseminated data will be critical for informing and tracking Africa's electricity transition. However, current electricity data available from national sources is limited, varies greatly by country, and, therefore, does not adequately contextualise the continent's electricity challenges and opportunities. Furthermore, national data is invariably published with long lag periods (often more than one year), which limits its usability and application in tracking volatile energy markets. More dynamic data availability, with greater granularity (monthly or better) and consistent fuel disaggregation, is needed to inform policy, decision-making and analysis of near-term market trends more directly.

While this is likely to improve over time, in concert with expanding ICT infrastructure and information frameworks, additional support and capacity-building efforts would accelerate this process. Particular attention should be given to improving national institutional capacity to implement wide-scale reporting on electricity production, and national energy balances more broadly, and to enhance electricity modelling techniques used in future planning and strategy development.

In addition, focus should be given to improving data transparency for national and regional transmission capacity – with support given to regional power pools to drive and implement these developments – as well as to facilitate greater data availability across the distributed renewable energy value chain, the scale-up of which will be critical for achieving SDG 7 by 2030.

Importantly, efforts should be placed on demonstrating the importance of coordinated open-access data initiatives and databases that help to identify and close critical energy data gaps on the continent, including building on the African Energy Commission's (AFREC) efforts.

Timely, reliable and publicly disseminated data will be critical for informing and tracking Africa's electricity transition.

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ABOUT THE AFRICAN CLIMATE FOUNDATION (ACF)

The African Climate Foundation, established in 2020, is the first African-led and -based strategic grantmaker and think-tank working at the nexus of climate change and development in Africa.

ABOUT THIS SERIES

The ACF commissioned a series of expert briefs undertaken for its Energy Access and Transitions Programme, focused on specialised topics on the political economy of Africa's power sector transformation, and the opportunities and challenges for scaling renewable-based electrification.

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ABBREVIATIONS AND ACRONYMS

ACF	African Climate Foundation
AfDB	African Development Bank
AFREC	African Energy Commission
ECOWAS	Economic Community of West African States
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IEA	International Energy Agency
IEP	Mozambique's Integrated Energy Plan
IRENA	International Renewable Energy Agency
KfW	German state-owned development and investment bank
SDG	United Nations Sustainable Development Goals

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