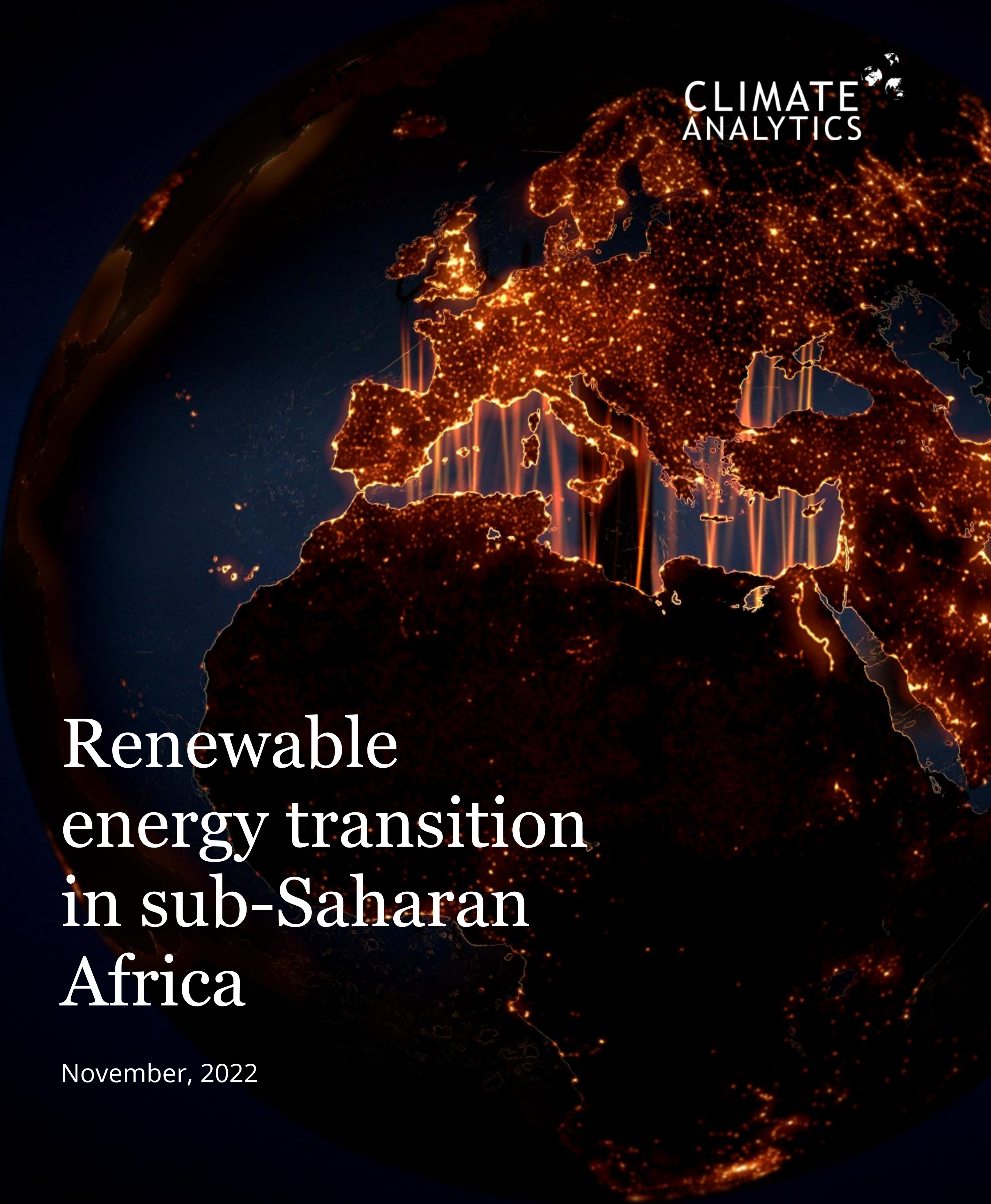

CLIMATE ANALYTICS

Renewable energy transition in sub-Saharan Africa

November, 2022

Authors
Deborah Ramalope, Carley Reynolds, Gaurav Ganti, Lara Welder, Claire Fyson, Mavis Mainu, Bill Hare

Acknowledgements
Winnie Khaemba, Robert Brecha, Diane Gedeon

We would like to acknowledge the German Federal Foreign Office who provided funding for this report.

Citation

This document may be cited as:
Climate Analytics (2022). Renewable energy transition in sub-Saharan Africa

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About the authors

Deborah Ramalope is the Co-Head of the Climate Policy team, and leads the team's policy analysis work. She has been working on climate policy for over 14 years. Prior to joining Climate Analytics, she worked for the South African government, leading a team responsible for the development of climate mitigation policies. Her work at Climate Analytics includes assessing the effectiveness of national governments 'targets, policies and action.

Carley Reynolds is a Climate and Energy Policy Analyst and contributes to several initiatives at Climate Analytics, including profiles for several African countries for the Climate Action Tracker (CAT), 1.5°C National Pathway Explorer and Climate Transparency Report. Carley also contributed to the CAT Natural gas in Africa report and CAT governance reports for Nigeria and Ethiopia.

Gaurav Ganti is a Research Analyst with the Climate Science and Impacts team at Climate Analytics. Previously, he led the decarbonisation strategies work with the Climate Policy Analysis team, providing scientific and policy relevant analyses on fossil-fuel phaseout requirements.

Lara Welder co-leads the modelling unit within the Climate Policy team at Climate Analytics. With her research expertise in the area of energy system modelling and optimisation, she contributes to the tool development within the team.

Claire Fyson is the Co-Head of the Climate Policy team and leads the team's mitigation pathways analysis work. Her work includes assessing NDC ambition and working with modelled pathways that are consistent with the Paris Agreement's 1.5°C warming limit.

Mavis Mainu, in her current role, provides organisational, conceptual and planning support. Prior to joining Climate Analytics, she worked in West Africa and Latin America managing rural off-grid projects, and creating government and private sector partnerships. She also worked at the IRENA, supporting programmatic work.

Bill Hare is the founder and CEO of Climate Analytics. He is a physicist and climate scientist with 30 years' experience in science, impacts and policy responses to climate change and stratospheric ozone depletion.

Contents

Executive summary

Sub-Saharan Africa[1] is at a pivotal crossroads in its development. Its choice of energy for the future will be decisive in achieving its sustainable development ambitions, including clean and affordable electricity access for all.

As recent IPCC reports have shown, sub-Saharan Africa faces very serious risks from climate change, especially with current policy pathways pushing the world towards 2.7°C of warming by 2100.

The IPCC AR6 Working Group II report found with high confidence that limiting global warming to 1.5°C is likely to substantially reduce damages to African economies and ecosystems. Exceeding this level of warming, even by 0.5ºC, is projected to result in impacts becoming widespread and severe, including reduced food production, reduced economic growth, increased inequality and poverty, increased human morbidity and mortality and major biodiversity loss.

Conversely, limiting global warming to 1.5°C will likely have a large positive impact on GDP across Africa, with clear benefits from a low emissions pathway emerging by 2030.

But at the moment, Africa's progress towards achieving critical sustainable development goals, particularly energy goals such as access to clean and affordable energy, are flagging and falling far behind 2030 targets. Universal access to clean and affordable energy is critical for economic development in sub-Saharan Africa to improve livelihoods, overcome gender issues, provide public services, enable industry development and ensure environmental sustainability.

Sub-Saharan Africa is home to more than half of the world's least developed countries where people earn less than US$1.90 a day.

The current energy crisis and Europe's search for a replacement for Russian gas has given rise to a trend towards greater interest in developing fossil fuel resources, particularly fossil gas for both domestic consumption and export, across the region.

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[1] Although the paper's focus is on sub-Saharan Africa (SSA), due to data unavailability for SSA, in some cases we present data for Africa as a whole.

At the same time, a larger energy system transformation is gaining momentum globally, driven in part by climate and energy policies aimed at meeting the Paris Agreement's 1.5°C goal, and enabled by the ongoing rapid reductions in the cost of renewable energy and storage technologies.

In this sense, sub-Saharan Africa stands at a crossroads: whether to expand investment in fossil fuel resources for domestic use and export, or whether to accelerate investment in clean and affordable renewable energy that can provide distributed or centralised power for rural and urban areas, as well as electrical power for industry, and potentially for export.

Africa has 60% of the world's best solar resources. The unique opportunity that sub-Saharan Africa has is to find a way of taking advantage of its relatively low level of incumbent fossil fuel infrastructure compared to many other countries, and a large and growing demand for clean and affordable energy.

This paper conducts a survey of the issues involved in taking advantage of this opportunity and looks at further critical work needed to advance this.

To date sub-Saharan Africa has not been able to take advantage of its abundant but underused renewable resources

Investment in renewables in sub-Saharan Africa has not been as strong as it needs to be to achieve sustainable development objectives. Data from IRENA indicates around 1.7% of global investment in renewable energy in the period 2010 to 2020 went into the region, which accounts for about 14% of the world population.

The International Energy Agency (IEA) estimated that in the last few years about 60% of energy investment in Africa as a whole still went to fossil fuels, with total 2021 annual energy investment around USD 90 billion.

In Africa as a whole, renewables accounted for about 14% of the total energy supply in 2020 and fossil fuels about 52% (IEA, 2021b). In the electricity sector, renewables accounted for about 21% and fossil fuels about 77% of generation.

The share of renewables in power generation in sub-Saharan Africa is a little higher, at 29% in 2019. But of this, 24% was from hydropower and only 5% from other renewable energy technologies. Since 2010, on average, only 0.8% of the globally added capacity of onshore wind turbines has been installed in Africa.

The paradox is that renewable energy technologies are already cheaper than coal and gas power plants in most African countries. Between 2010 and 2021, the global cost of utility-scale solar PV electricity generation dropped by 88%, and the cost of onshore wind fell by 68%. Battery storage has also seen a rapid decline in costs, one study estimating about three quarters decline between 2012 and 2019.

Rapid growth in electricity generation is needed to overcome energy poverty and supply power for growing industry

The IEA estimated in its 2022 Africa outlook that sub-Saharan Africa would need to nearly triple its power supply by 2030 to provide universal energy access as well as power for the electrification of industry and ultimately transport.

According to IEA estimates, the growth rate for electricity generation in sub-Saharan Africa would need to be about 7% per year to achieve universal energy access by 2030 - and excluding South Africa about 10% per year.[2] Total growth rate for generation between 2015 and 2020 in all Africa was around 1.7% p.a., and sub-Saharan Africa around 2.2%. Achieving about a 7% growth rate per annum would therefore be a significant increase.

On the positive side, the available data indicates that in Africa as a whole there has been an annual average growth rate of around 46-52% in installed solar PV and about a 23% growth rate in installed wind capacity over the last decade to 2020.[3] This is from a very small base, but the continuation of growth rates like this, if enabled by the kinds of policy measures that we cover in this paper, could really make a difference.

Whilst the IEA has suggested the use of gas power for desalination, a much more sustainable option is to use renewable electricity. A higher share of renewables, including with integration into the hydropower system to use this as storage, could assist with desalination needs and lower water production costs (Denton & Halsnæs, 2022; Caldera & Breyer, 2020). While the outlook for conventional hydropower is quite clouded due to the projected effects of climate change in much of the region, there are substantial opportunities for its use as storage in large scale power pooling arrangements.

[2] The overall growth rate for Africa as a whole in the IEA's 2022 SAS scenario is about 5% per year, with North Africa projected to need only about 2% growth rate in order to meet energy access and other goals for 2030. The last five years the total growth rate for Africa have been about 2%p.a. in electricity generation.

[3] Lower growth rates from IEA data and higher from IRENA estimates.

However, the current pipeline is not adequate to meet the region's increasing energy demand, and there is an urgent need to further develop the policy frameworks that will enable and sustain a large-scale renewables pipeline in sub-Saharan Africa.

If an enabling environment for renewables is not created in the region, and sufficient financial flows are not unlocked, there is a high risk of lock-in of carbon intensive infrastructure if fossil fuels are prioritised to meet urgent energy needs.

Synergies between green hydrogen development and urgent domestic energy needs are possible

Numerous studies have shown Africa's high potential as a major green hydrogen producer and exporter; however, it is extremely important that providing energy for domestic use and overcoming energy poverty in the region are prioritised.

Sub-Saharan Africa has been found to have the greatest technical potential globally to produce green hydrogen at under $1.50 a kilogram by 2050. Green hydrogen could be used for fertiliser manufacture, green steel as well as an industrial energy source in the region. According to IRENA, there are important synergies between renewable energy and hydrogen production, with hydrogen spurring a more rapid growth in renewable energy power and lower levelised costs, increasing the availability of renewable solutions for industry, providing flexibility for electricity grids and in appropriate circumstances providing storage capabilities (IRENA, 2019).

Water scarcity in the region will need to be factored into decisions regarding hydrogen production, so that water needed for electrolysis doesn't add competition for freshwater resources. Current analysis of hydrogen production costs indicate that desalination of non-potable water would add only about 5% to the cost of hydrogen production and hence there should be no competition with potable water for human and livestock consumption.[4]

Barriers limit renewable energy development in sub-Saharan Africa

A complex variety of barriers have so far limited uptake of renewable energy. The COVID-19 pandemic has exacerbated these challenges by disrupting project implementation and impacting public finances.

Countries in sub-Saharan Africa have not received the promised climate finance required to fund the energy transition, while international support and investment in

[4] https://www.allens.com.au/insights-news/insights/2021/10/Water-access-for-hydrogen-projects/

fossil fuels has continued. While official development assistance (ODA) for renewable energy in the region has increased, it is still far below what's needed to mobilise sufficient private sector investment (OECD, 2022). In addition, it is also clear from recent research that national context is very important for the effectiveness of ODA in promoting renewables and needs to be taken into account.

Further, the high perceived risks of renewable energy investments in the region mean that investors require a higher rate of return, and projects face high financing costs and limited availability of long-term financing. Renewable energy projects face a lack of institutional knowledge, and are competing with heavily subsidised fossil fuel consumption and production in many countries.

Institutional barriers in particular are country-specific and broad generalisations, such as corruption, should not be assumed to be applicable to each country.

Key financial institutions still support fossil fuels

Financial institutions still support at least some segments of the fossil fuel value chain.

While most institutions do not support new coal capacity for power generation, they continue to support fossil gas power generation. There are data gaps and lack of coherent data sources for key energy actors in Africa. Annex A provides a list of some of the key actors identified.

Amongst multilateral finance institutions, the African Development Bank provided the most fossil fuel finance in Africa for the period between 2016 and June 2021, with the World Bank following in second position.

The Industrial and Commercial bank of China (ICBC) provided the most finance in the private sector category. The IEA 2022 Africa report reveals that due to a shift in focus of China's banking policy towards domestic projects, China's funding for African electricity projects has declined, with lending falling from around USD 8 billion in 2016 to about USD 1.5 billion in 2019.

Datasets and analyses on financing for fossil fuels and renewable energy are not often directly comparable, as fossil fuel financing estimates can include extraction as well as generation. But studies have shown that the amount spent on renewables is far less than what was invested in fossil fuel projects in Africa.

A 2022 Oil Change International study of 58 fossil fuel projects and 24 fossil fuel companies shows that a total of USD 132.3 billion was invested in fossil fuel projects and companies in Africa during the period 2016 - June 2021 (Oil Change International, 2022). A separate IRENA study indicates that Africa received only 2% of the USD 2.8 trillion that was invested in renewables globally between 2000 and 2020 with average annual investment growing to about USD 5 billion per year in the 2010-2020 period (IRENA, 2022b).

This data indicates that the average annual investment in Africa in recent years in fossil fuels was around USD 33 billion per year and in renewables around USD 5 billion per year. In other words, annual fossil fuel investment appears to be 6-7 times greater than renewables in recent years.

Renewables financing in Africa is dominated by loans, accounting for about 78% finance for renewable energy capital (IRENA, 2022b). Loans are very important, in particular for private sector investments at scale which will need to happen if the renewable energy transition is to occur in sub-Saharan Africa; however, it's also clear that loans can exacerbate developing countries' debt burdens, worsen poverty and increase dependency on international aid. This is a factor that needs to be taken into account when designing the policy framework to support the renewable energy transition in sub-Saharan Africa.

The risks of exploiting fossil fuels

One of the key risks that sub-Saharan Africa will run into now when investing in fossil fuel infrastructure, both for domestic consumption and export, is that of a lock-in effect. As the world moves to decarbonise, the decline in gas demand will follow quite closely behind the reduction in coal.

This means that if sub-Saharan African countries invest in fossil fuel infrastructure, they risk locking in high emissions, burdening their economies with stranded assets, and potentially losing out on a major economic opportunity to invest in renewable energy.

Numerous academic studies have shown that the so-called resource curse is a very real, current and concerning phenomenon in sub-Saharan Africa: countries focused on resource development such as Nigeria do not show the economic and social benefits one would expect (Mihalyi & Scurfield, 2020). Studies show that most revenues generated from fossil fuel projects are owned by multinational companies and do not remain in the sub-Saharan countries where they are generated. In Nigeria 55 million people are still without access to electricity, and it has the greatest number of people in extreme poverty on the planet.

Other countries have been able to avoid the resource curse, as is the case in Botswana due to stronger governance and economic policies (Sarraf & Jiwanji, 2001). However, the current situation in Mozambique, where the government has taken on debt in advance of future tax revenue from promised LNG development is an illustration of the risks that this mode of development runs.

An ill-designed strategy to export green hydrogen from the region, at the expense of fulfilling domestic energy needs could of course have similar problems. This points to the fact that the clean energy transition in sub-Saharan Africa needs to be holistically framed around supporting just and sustainable development, stronger and inclusive governance, a strong civil society, and much higher levels of capacity.

Renewable energy projects, particularly distributed solutions such as mini-grids that are necessary to extend energy access, tend to be smaller and more decentralised than fossil fuel projects, allowing for a variety of ownership models. However, improved governance and transparency are still necessary to ensure economic benefits remain in the region (Opfer et al., 2022).

Another issue is the drive for new fossil gas developments in Africa, including massive LNG export LNG export developments, in response to the current energy crisis triggered by Russia's illegal invasion of Ukraine. This strategy is justified publicly as one that could create opportunities and stimulate economic growth and contribute to universal access to energy in African countries. However, there is a wealth of evidence that suggests that this will not be the case.

Under the IEA's 1.5°C compatible Net Zero Roadmap (IEA NZE) it is projected that African LNG exports would have to peak by 2025 and begin dropping to quite low levels below 2005 levels by 2030 (IEA, 2021a). In this scenario, total African gas production would also need to peak by around 2025 and below 2010 levels by the mid 2030s. It should be noted that the IEA NZE gas use is significantly higher than many other Paris compatible pathways through the 2030s, so that it is quite clear that if the world implements the Paris Agreement the prospects for ongoing markets for new gas from Africa are quite dim.

If the world implements the Paris Agreement, then there is substantial doubt as to whether new fossil fuel export projects can actually succeed. There are clear trends of increased renewable energy ambition globally. The European Union (EU), for example, is increasing its renewable generation target and projections indicate it is likely to exceed its 55% emission reduction target for 2030. This means that the short-term need for replacement of Russian gas will be just that, short-term, and beyond the next few years overall gas demand is projected to continually decrease in the EU.

The July 2022 IEA quarterly assessment and medium-term outlook look for the global gas market also indicates that the growth in gas demand is 60% lower by 2024 than previously forecast, and prices are likely to remain high. In particular this would affect the cost of gas for industrial activities, and fertiliser manufacture.

A key point to be aware of in the African context of expanding LNG production, is that LNG manufacturers will want to take advantage of the high global price for their product and this will create serious difficulties for access to cheap gas domestically.

Additionally, a study by McKinsey shows developing gas and oil fields in Africa is about 15-20% more costly and up to 80% more carbon intensive than other fields globally, pointing to potential competitiveness issues for new liquified natural gas (LNG) export developments. New African LNG will face significant competitive pressures if not disadvantage from incumbent producers, or producers with intrinsically lower cost structures.

The IEA recommends accelerating the development and implementation of clean energy transition policies.

Renewable energy development has multiple benefits for sub-Saharan Africa

Managing a just transition of sub-Saharan African energy systems to renewable energy can generate benefits beyond reduced emissions. Developing job markets for renewable energy can create more sustainable employment opportunities that replace jobs lost in the fossil fuel sector, and foster economic growth. The recent IRENA African market study shows that the increase in job opportunities from the renewable transition will substantially outweigh job losses in the fossil fuel industry over the next decades in the region (IRENA, 2022b).

The diversification of fossil fuel export dependent economies is also crucial for the economic stability and long-term growth of these countries. As the COVID-19 pandemic showed, government budgets reliant on oil and gas revenues are extremely vulnerable to global energy price shocks and can leave countries unequipped to respond to crises. Expanding renewable energy access would not only reduce these dependencies, but allow countries to develop other sectors and industries.

Transitioning away from fossil fuels would also mean improved health, security and livelihoods from reduced pollution and fossil fuel-driven conflict. The recent IRENA World Transitions Outlook highlights some very substantial benefits for Africa from pursuing a 1.5°C pathway compared to present policies, including 6.4% additional GDP growth by 2050, 3.5% more jobs and a 25.4% higher welfare index.

Creating an enabling environment is critical for the deployment of renewable energy in sub-Saharan Africa

Scaling up renewables, but in particular the integration of renewable energy into power systems, requires institutional capacity, knowledge and resources that are limited in many sub-Saharan countries. Current capacity building models (e.g., theory-based approaches) have not always been effective. To ensure sustainability, country-ownership and maximum effectiveness, more learning-by-doing approaches should be implemented as part of capacity building programmes.

Public and private finance, domestic institutional and policy environments, and regional cooperation are key tools for overcoming the barriers that limit renewable energy deployment.

Adequate finance is one of the most crucial enabling factors for countries of sub-Saharan Africa to accelerate its energy system transformation and provide universal access to clean energy. Key channels through which finance can catalyse the transition include supporting energy system planning and market design, strengthening the bankability of projects, and supporting and facilitating the development of domestic financial incentives.

Matching the type of financial instruments to the need is important, with concessional funding, blended finance, grants and guarantees providing important options for de-risking and catalysing private sector investment, without creating additional debt burdens. Africa is saddled with high-levels of debt which makes it an unattractive investment destination, and the pandemic has worsened the debt landscape in many countries. While there has been progress on de-risking approaches in Africa, including the establishment of green banks, and blended finance instruments, these have not yet had the scale of success needed for a range of different reasons.

Institutional capacity building and support for energy policy design and implementation are also necessary for fostering a bankable pipeline of renewable energy projects and reducing the perceived risk of these projects. While sub-Saharan Africa has made progress in improving its readiness for renewables over the past few years, the region still falls behind other parts of the world in terms of its legal and policy frameworks (ESMAP, 2020).

Regional cooperation will be key to enabling reliability of renewable energy systems in sub-Saharan Africa. Entry points to enhance the reliability of renewable energy systems are grid interconnection and power pools. As renewable energy resources are not uniformly distributed in the region, these resources can in principle be optimised through regional cooperation initiatives, such as the West African Power Pool.

So far it is clear that the regional power pool systems have not worked as effectively as they could and will need to in the future. This is due to a variety of institutional and infrastructure issues which will need to be addressed. As IRENA has noted, issues include a lack of aligned national policies and regulations, inadequate investment in grid and other infrastructure, and a lack of funding.

The pressure that the region's hydropower resources face from climate change also underscores the need for cross boundary transnational coordination, in which hydropower resources can complement variable renewable energy and help regions cope with drought and other pressures on their water resources. In other words, increased regional cooperation around energy is an important adaptation measure for the region and will help build climate resilience.

International public funding is necessary to develop pilot projects to identify approaches that work across different groups of countries in the region. There is an element of learning by doing to design power pools for renewable electricity systems, for which governments and other private actors may not be willing or able to allocate their own resources. In parallel, external public funding can catalyse the adoption of harmonised technical standards, reducing the time lag between identification of pilot projects that work, and scaling them up.

The case for a sub-Saharan Africa energy transition support deal

Clean energy will be at the heart of sustainable development and climate resilience prospects for sub-Saharan Africa and critical to reducing poverty, providing access to clean and affordable energy to those that do not have it, and to powering industry in the region.

It is likely that any successful approach to dealing with the issues identified in this report will need to take as its starting point a focus on sustainable development and climate resilience development, joining together adaptation and mitigation concerns across the region. This message comes very strongly through the Africa relevant chapters of the IPCC AR6 reports on impacts and mitigation (Trisos et al., 2022; Schipper et al., 2022 & Denton & Halsnæs, 2022). Any framing mainly or solely around energy would not attract the broad support and engagement needed for the transformations described in this report, nor is it likely to be successful even in its own terms in the long run.

Approaches to supporting the rollout of renewable energy need to take these goals into account in order to support sustainable development.

It is clear that many basic measures have been tried and supported by various governments and organisations, but efforts would need more time and resources to be impactful and transform sub-Saharan Africa's energy system. It is also clear that further work is needed around what policies have been impactful and what needs to be done to make them more effective at the national level.

In this report we present the **recommendations** below. What is suitable and what should be prioritised will depend on the specific country context.

- There is a need for specific ambitious national and regional commitments for renewable energy deployment.

- Sub-Saharan African countries continue to need support in developing and strengthening institutional capacities. Building capacity across all levels of government can help embed knowledge in local institutions and bring innovative business models.

- Support is needed for long-term energy system planning and market design, to facilitate the development of infrastructure, supply chains and energy markets that can support a high penetration of renewables.

- Measures need to be put in place that eliminate market distortions in favour of fossil fuels.

- Unlocking and increasing private and public sector finance requires the de-risking of renewable investments, the development of innovative financial instruments, and increased international support for implementing these recommendations.

- Support is needed to implement measures to improve energy efficiency in buildings, appliances, industry and transport.

- An improved availability of granular, open-access data can allow policy decisions to be data-driven, and facilitate transparency and accountability. This can also facilitate awareness raising among citizens on the benefits and the need to take up renewable energy technologies.

Introduction

Sub-Saharan Africa hit hard by multiple crises

The pandemic has exacerbated Africa's socio-economic issues. Over the past two years, progress towards achieving the sustainable development goals (SDGs) has slowed down or reversed in sub-Saharan African countries that have been impacted by the slow rollout of vaccines and reduced international support as countries dealt with the pandemic domestically.

While sub-Saharan Africa (SSA) experienced stronger than expected economic recovery in 2021, the region has now been hit hard by inflation and the current energy and food crises, while public debt ratios are higher than they have ever been in this century (IMF, 2022). The recent IPCC report shows that not limiting global warming to 1.5^{o}C will intensify the continent's existing challenges and increase damages to African economies and ecosystems (Trisos et al., 2022).

Current state of energy in sub-Saharan Africa

Sub-Saharan Africa is the least electrified region in the world (IEA et al., 2022). As electricity access and clean cooking gaps remain (only 48% have electricity access and 17% have clean cooking access), traditional biomass still accounts for almost half of sub-Saharan Africa's primary energy mix (IEA, 2022; IRENA, 2022b).

Fossil fuels account for most remaining energy sources, with high shares of oil and coal (largely in South Africa) and a growing share of natural gas. Renewable energy excluding traditional biomass accounts for almost one-fifth of sub-Saharan Africa's primary energy mix. Solar, wind and geothermal play a small but growing role in the energy mix (about 1%), while hydropower accounts for 1.7% of the region's primary energy (IEA, 2021b).

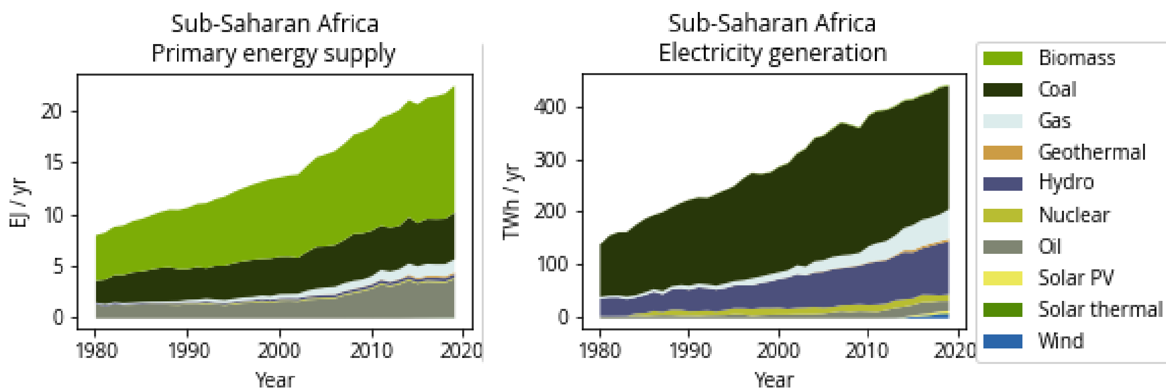

Figure 1. Primary energy supply and electricity generation by source in sub-Saharan Africa, 1980 to 2019. (IEA, 2021b)

Electrification rates across end-use sectors remain low. Industry has the highest rate of electrification at 26% as of 2017. In the transport and building sectors, electrification remains very low, at 1% and 4%, respectively (IRENA, 2020).

While countries across sub-Saharan Africa face a variety of challenges, there are some key issues that are common across the region. Sub-Saharan Africa is home to more than three quarters of people globally who don't have access to electricity. While the share of the population with electricity access marginally improved from 46% in 2018 to 48% in 2020, the increase in population means the total number of people in sub-Saharan Africa still lacking access has grown (IEA et al., 2022). Additionally, as industry and commerce especially in the agriculture sector grows, demand for energy will also grow.

The sub-Saharan region also suffers from severe grid reliability issues, with frequent and prolonged blackouts resulting in a high dependence on expensive and polluting back-up generators (IEA, 2019). The affordability of energy is a key barrier for many sub-Saharan Africans, particularly as the COVID-19 pandemic has impacted household incomes and the current energy crisis has increased prices. Any intervention to address energy access issues would also need to ensure affordability for poor communities.

Access to clean cooking is limited, with some 923 million sub-Saharan Africans (83%) without access (IEA et al., 2022). Sub-Saharan Africa is the only region where this deficit is rising.

By sub-region, energy access across sub-Saharan Africa varies (IRENA, 2022b). Southern Africa has the highest access rate for clean cooking access in sub-Saharan Africa (37% in 2019) and about average access to electricity (49% in 2019). East and

West Africa have large discrepancies between populations with electricity access (46% and 53%, respectively) and populations with access to clean cooking (7% and 13%, respectively). Central Africa has the lowest electricity access rate at 32% in 2019 and about average access to clean cooking at 17%.

Key financial actors in energy development in Africa

Renewables are competing for funding with fossil fuels. Multilateral development banks still support fossil fuels, mainly fossil gas power generation. The IEA estimates that over the last five years, about 60% of investments in Africa's energy projects was spent on fossil projects, particularly oil and gas (IEA, 2022).

Fossil fuel financing

Significant scaling up of renewables would require development finance institutions to stop the financing of all forms of fossil fuels, and prioritise renewable energy sources. However, given the scale of funding that is still channelled towards fossil fuel projects, that is far from being achieved.

Between 2016 and June 2021, the African Development Bank (AfDB) was the multilateral finance institution that provided the most fossil fuel finance in Africa, followed by the World Bank and African Export-Import Bank. The China Development Bank, followed by the China Export-Import Bank and Export-Import Bank of the United States led national finance institutions by providing the most finance to support Africa's fossil fuel projects.

While the largest financier was the China Development bank, the majority of large funders were from the US, the UK and France. In terms of private sector finance, the Industrial and Commercial bank of China (ICBC) and the Bank of China provided the most finance (Oil Change International, 2022).

The recent IEA special report on African energy shows that China’s funding to Africa's electricity projects has been on the decline in recent years, from around USD 8 billion in 2016 to about USD 1.5 billion in 2019. This is mainly due to changes domestically, with China's policy banks funding more domestic projects. China development banks have been providing finance support mainly as low-cost loans (IEA, 2022).

Table 1: Fossil fuel finance to Africa by region (2016-June 2021)

	Fossil fuel finance by region	**% share**
Private sector	Asia	41.4%
	European and North American	40.0%
	Africa	16.9%
Public sector	Asia	57.2%
	Europe and North America	25.7%
	Africa	10.3%
	Other	6.8%

Source: (Oil Change International, 2022)

Renewable energy financing

Data sets and analyses on financing for fossil fuels and renewable energy are not often directly comparable, as fossil fuel financing estimates can include extraction as well as generation. However, studies show that Africa falls behind other regions on renewable investments, getting only 2% of the USD 2.8 trillion invested globally for renewables between 2000 and 2020 (IRENA, 2022b). This amount is far less than what was spent on fossil fuels in Africa. An analysis of 58 fossil fuel projects and 24 fossil fuel companies shows that USD 132.3 billion was invested into fossil fuel projects between 2016-June 2021 (Oil Change International, 2022).

Renewable energy financing in Africa is dominated by loans, accounting for 78% of renewable energy finance. For public financing, 88% is in the form of debts, and 10% in the form of grants. The largest financier between 2010 and 2019 was China, who also made the same amount of investment in fossil fuels, mainly coal (IRENA, 2022b). Loans are very important, in particular for private sector investments at scale which will need to happen if the renewable energy transition is to occur in sub-Saharan Africa; however, it's also clear that loans can exacerbate developing countries' debt burdens, worsen poverty and increase dependency on international aid.

Official development assistance (ODA) for the energy sector in sub-Saharan Africa has increased from 2008 to 2019, largely driven by an increase in finance for grid development, renewable energy and energy research, policy support and training (OECD, 2022). ODA for fossil fuels in the region has remained low even while fossil fuel ODA globally surpassed that for renewables in 2019.

This, along with the magnitude of the gap in overall finance (public and private) between renewables and fossil fuels, indicates current ODA in sub-Saharan Africa has been insufficient and/or inefficient in catalysing the transformational change needed for the energy transition. However, external factors, such as the COVID-19 pandemic, also need to be considered when assessing the impact of finance so far. More detailed analysis would be needed to assess the impact of ODA on deployment of renewables in SSA.

There are regional differences in renewable energy investment trends in sub-Saharan Africa between 2010 to 2020. Southern Africa received the highest share of renewable energy investment inflows, of USD 22.4 billion accounting for 40% of total inflows. East Africa received USD 9.7 billion, West Africa received USD 4 billion and Central Africa received the least, USD 1.3 billion (IRENA, 2022b). Outside the sub-Saharan African region, North Africa received the second largest renewable energy investment in Africa, in the amount of USD 17.5 billion accounting for 32% of total inflows (IRENA, 2022b). Renewable energy finance flows also vary widely by countries, with investments concentrated in more mature markets, such as South Africa and Nigeria.

There are data gaps in renewable energy financing in Africa, with some of the data sources presenting incomparable categories. This is an area that requires attention to enable the tracking and monitoring of scale and sources of finance invested in renewable energy projects in sub-Saharan countries.

Enabling the transition

Renewable energy potential in Africa

Africa has abundant renewable energy resources, having 60% of the best solar resources globally (IEA, 2022). However, these have not been fully exploited, with the share of renewables in power generation in sub-Saharan Africa at 29% in 2019 (24% hydro, 5% other RES) (IEA, 2021b).

The falling costs of renewable energy present an opportunity to unlock this potential and generate electricity from renewable energy. Between 2010 and 2021, the global weighted average cost of utility-scale solar PV electricity generation dropped by 88%, and the cost of onshore wind fell by 68% (IRENA, 2022c). These technologies are cheaper than coal and gas power plants in most parts of Africa (IEA, 2022). This is especially true where capacity is procured through a competitive auction, and with the right policy and regulatory frameworks in place.

However, progress in Africa has not been as positive as at the global level for all renewable technologies. For example, since 2010, on average, only 0.8% of the globally added capacity of onshore wind turbines has been allocated to Africa (*Barriers to scaling up renewables are discussed below*) (IRENA, 2022a).

Compared to other (fossil fuel, nuclear) power plants, solar and wind also come with the benefit of short construction lead times, meaning electricity access could be fast-tracked if these technologies are implemented.

A range of zero carbon options for dispatchable power generation - including long-term storage and geothermal - can be combined with variable renewables to balance the grid. Utility scale battery storage, which is necessary for grid balancing, has seen rapidly declining costs. For example, Bloomberg estimates that the costs have fallen by about three quarters between 2012 and 2019 (Henze, 2019).

Africa's renewable energy (onshore only) generation potential is more than 1,000 times the projected power demand in 2040 (IRENA, 2020). According to IRENA, the estimated technical potential per technology is:

- Solar PV: 1,449,742 TWh/y
- Wind: 978,066 TWh/y
- Biomass: 2,374 TWh/y
- Hydropower: 1,478 TWh/y
- Geothermal: 105 TWh/y

These estimates are based on geography and resource availability, and do not take socio-economic and legal factors into account, but they indicate the vast renewables potential that Africa holds. For comparison, Africa's installed renewable electricity capacity was about 53.4 GW in 2020, with total renewable electricity generation of around 173 TWh/year in 2020 (IEA, 2021b). This shows that a lot of renewable potential is yet to be exploited.

In its recent African Energy Outlook, the IEA has published a scenario for meeting all Africa's energy-related development goals, nationally determined contributions (NDCs) and net zero targets, the Sustainable Africa Scenario (SAS) (IEA, 2022). The IEA's SAS does not appear to be embedded in its global Net Zero Emissions (NZE) scenario, and instead is drawn from its 2021 Sustainable Development Scenario (SDS). Whilst the NZE scenario is fully Paris Agreement compatible, the SDS scenario was not.

What this means is that the IEA SAS does not fully reflect the energy system changes at the African level required to meet the global NZE pathway. One of the consequences of this mismatch is that the energy export opportunities in the SDS are fundamentally different from those found in the NZE pathway, including for liquefied natural gas build-out, which is a big theme in Africa at present.

Although the SAS scenario is not Paris Agreement compatible in the sense described above, it illustrates that current targets are consistent with a strong increase in renewable power generation, energy efficiency and electrification, if fully implemented. It also shows the potential for Africa to become a major green hydrogen producer exporter (*see section on green hydrogen below*). The IEA report shows mini grids and standalone solar systems as the best option for achieving energy access in rural Africa where the majority of the energy poor are located.

It is likely that a full NZE pathway for Africa would show a reduced future demand for fossil gas, particularly in the industry sector, with green hydrogen and electrification occurring faster. A separate analysis by Barasa et al. (2018) has shown what a 100% renewable power system could look like in sub-Saharan Africa, including renewable synthetic gas production and water desalination (Barasa et al., 2018).

In the IEA SDS scenario, total renewable generation would accelerate from about the recent 5% per annum growth rate to 16% for the whole of Africa for the period 2020 to 2030. In this scenario it is unusual that the rate of photovoltaic rollout does not increase substantially above recent five-year growth rates going from about 32% to 36%. Given the very low technical costs of photovoltaics in Africa, if the barriers discussed below can be removed or alleviated, much higher growth rates should be able to be achieved. Similar comments can also be made in relation to onshore wind in much of the region.

However, the current renewables pipeline is not adequate to match with Africa's huge potential, despite the anticipated growth in electricity generation (Alova et al., 2021). This implies a high risk of lock-in to carbon-intensive infrastructure, and points to the urgent need to develop renewable project pipelines.

Barriers to renewable energy

Progress towards more widespread adoption of renewable energy in sub-Saharan Africa has so far been limited due to multiple financial, economic, and institutional barriers. These barriers are not limited to energy system transformations; policymakers in sub-Saharan Africa face multiple competing objectives (poverty reduction, ensuring economic growth, provision of modern energy access) as well as the need to respond to multiple proximate crises (the COVID-19 pandemic and the energy and food crises prompted by the Russian invasion of Ukraine).

Financial and economic barriers

While financial and economic viability of renewable energy is well established in many regions, high perceived investment risks in sub-Saharan Africa mean that investors require a higher rate of return.

A number of factors contribute to this. Non-hydro renewables lack a strong track record in many sub-Saharan African markets, entail high up-front capital costs, and can have payback periods longer than for fossil fuel projects, all of which make them less attractive to lenders that have limited experience in renewable energy investments. Off-grid systems (e.g., mini grids and stand-alone systems) face particular challenges because they often face a higher cost of capital than on-grid systems (Agutu et al., 2022).

These technology-related perceived risks are exacerbated by country-specific risks. For example, high foreign exchange risk arises because projects in sub-Saharan Africa are commonly financed in hard currencies, such as USD or EUR, while project revenues and assets are in local currencies at risk of depreciation. Foreign exchange risk and convertibility risk have been cited as the biggest challenges in bringing projects under Ethiopia's renewable energy auctions to financial close (Ayele & Shen, 2022).

A key challenge is that renewable energy also has to compete with fossil fuel projects, often on an unequal playing field. Compared to fossil fuel projects, renewable energy projects are often smaller, meaning they have higher transaction costs. While their operation costs are low, the upfront costs are still high. This results in increased sensitivity to the cost of finance (UNEPFI, 2012).

Renewable energy projects also face a lack of institutional knowledge, and are competing with heavily subsidised fossil fuel consumption and production in many countries. Fossil fuel subsidies eat into government budgets and leave countries vulnerable to fluctuations in energy prices. Nigeria, for example, expects to spend USD

9.6 billion in 2022 on fuel subsidies, almost ten times more than budgeted due to Russia's illegal invasion of Ukraine (Osae-Brown, 2022).

Where concessionary finance is available, the limited pipeline of viable renewables projects in sub-Saharan Africa, which is largely concentrated in more mature markets such as South Africa and Kenya, is an additional barrier to renewables expansion (Center for Global Development, 2022). This points to a need for more funding for early-stage project development.

Political, regulatory and institutional factors such as inadequate transmission and distribution infrastructure, limited or absent legal frameworks, and weak institutional capacity also contribute to the overall risks (*see section below for institutional barriers*).

Institutional barriers

While renewable energy has been successfully integrated into power systems around the world, institutional barriers in sub-Saharan Africa have slowed progress towards the energy transition. These barriers in particular are country-specific and broad generalisations, such as corruption, should not be assumed applicable to each country. The Climate Action Tracker governance series examines many of these barriers in depth for some sub-Saharan countries including Ethiopia, Nigeria, Kenya, Ghana and South Africa (Climate Action Tracker, n.d.).

Underinvestment in many utilities across sub-Saharan Africa and their poor financial performance have crippled the utilities' ability to maintain grid infrastructure, engage in long-term energy planning and attract finance. Over half of the region's utilities are unable to cover their operating costs and many face insolvency (IEA, 2022).

The unsustainable state of utilities has led to inadequate or poorly maintained grid infrastructure with high loss rates and other issues. The weighted average transmission and distribution losses in sub-Saharan Africa excluding South Africa were around 23%, reaching more than 40% in the Comoros, São Tomé and Príncipe, the Republic of Congo, and the Central African Republic (Trimble et al., 2016). These grids were developed to accommodate conventional, mainly fossil fuel resources. Investment will be required to modernise grids for the scale up of variable renewable sources, such as solar PV and wind.

Beyond the financial health of utilities, issues around cost overruns of projects and inefficiencies remain a key concern. For instance, a project led by the Kenya Power and Lighting Company (operates transmission and distribution systems), which subsidised connection fees, increased the number of electricity connections. However, cost overruns and a lack of ability to recover costs from the new connections have compromised the effectiveness of the programme (Shirley, 2018). This example points to the importance of electricity system governance reforms in expanding electricity access.

A recent paper, using 32 years of data from over 100 countries found that a reform programme, when successfully undertaken, increased power connection rates and per-capita residential consumption,[5] with particularly strong effects on connection rates in sub-Saharan African countries (Dertinger & Hirth, 2020). The reforms studied in this paper include increased competition, independent regulatory agencies to improve oversight and accountability, unbundling of utilities and increased choice of suppliers (Urpelainen & Yang, 2018).

Specifically, for sub-Saharan African countries, Dertinger and Hirth (2020) find that each reform highlighted above, when successfully implemented, resulted in a 20% increase in the number of power connections.[6] This relationship between institutional capacity and increased benefits to the population is also identified by Ahlborg et al., (2015), who find a positive relationship between institutional quality and per capita household electricity consumption.

Sub-Saharan Africa has made progress in improving its readiness for renewables over the past few years, but the region still falls behind other parts of the world in terms of its legal and policy frameworks (ESMAP, 2020). Without the necessary institutional capacity many governments in Africa will not be able to implement relevant policies that encourage the deployment of renewable energy such as feed-in-tariffs and renewable procurement programmes.

Enabling environment/conditions

Fostering enabling environments at the national and regional levels will be crucial to overcome the barriers identified above. In this section, we focus on the role of finance (public and private), domestic institutional and policy environments, and regional cooperation. Given the diversity in regional circumstances, and the need for different techno and socioeconomic solutions to meet regional needs for a low carbon transition, the specific role of these enabling conditions will vary between countries.

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[5] Note that an increase in per-capita electricity consumption, while positive, does not detract from the broader argument that this electricity, when primarily generated by fossil fuels, has not necessarily resulted in broader sustainable development objectives being met.

[6] The authors do not provide specific results at the country level.

Finance

The adequate availability of finance is one of the most crucial enabling factors for countries of sub-Saharan Africa to accelerate their energy system transformation and provide universal access to clean energy. Improving coordination between government ministries to identify options to access existing sources of finance is also important to ensure that scaled up levels of finance available is matched by improved readiness levels to access the finance on part of the recipient governments.

There are three channels through which finance can catalyse the transition (IEA, 2022):

1. **Support energy system planning and market design** - this includes the creation of a knowledge base and associated policy designs and reforms to facilitate the renewable energy transition.
2. **Strengthen the bankability of projects** - this includes measures that help reduce the perceived risk associated with projects in sub-Saharan Africa. When the perception of risk is reduced, projects can raise capital at lower rates of interest, increasing the viability of the projects.
3. **Support and facilitate the development of domestic financial initiatives** - given the scale of finance necessary to ensure that sub-Saharan countries are on a sustainable development path to meet the Paris Agreement climate objectives, finance will need to be mobilised from multiple sources, including shifting finance flows into renewables.

The following three examples provide an illustration of the role finance can play through each of these channels. In two of the cases, we observe cases in which finance is an enabler across multiple channels.

Case 1: **Supporting energy system planning** and **strengthening the bankability of projects** - *Nigeria Integrated Energy Planning Tool*

This initiative was supported by philanthropic funding (SEforALL, 2022). The purpose of this initiative was to fund the development of a geospatially disaggregated modelling tool (SEforALL, 2022) to help guide policy decisions to expand access to electricity and clean cooking at the lowest cost. In collaboration with the SEforALL initiative, the Nigerian government has used this tool to prepare an integrated energy plan to meet the goals of universal residential electrification, institutional electrification and access to clean cooking. There are two benefits to such an initiative:

1. It allows policy decisions to be data driven, and, with granular data availability, potentially facilitates the efficient use of financial resources;

2. The public availability of this data facilitates transparency and increases government accountability.

The latter can help reduce the perceived risk associated with renewable energy planning and deployment in sub-Saharan Africa. When used for long-term planning, such tools can also help ensure that new privately financed grid-connected renewable projects can be well integrated. This is important because projects that cannot be absorbed by the economy risk damaging the utility's financial stability (KfW, 2020).

Another example of a tool being used to guide an emerging technology is the H_2 Atlas, which is funded by the Bundesministerium für Bildung und Forschung (BMBF). The aim of this tool is to support decision-making by estimating the potential for green hydrogen production in sub-Saharan Africa (H2 Atlas, 2022). Upscaling such geospatially resolved energy planning decision tools, which should be aligned with Paris Agreement compatible system transformations, is key (Climate Analytics, 2021a; Climate Analytics 2021b) as is a comprehensive assessment of the co-benefits of these system transformations (Climate Analytics, 2021c).

Case 2: **Strengthening the bankability of projects** and **scaling locally available solutions** - *Beyond the Grid Fund for Africa*

The Beyond the Grid Fund for Africa (BGFA, 2022) initiative recognises the important role that off-grid energy solutions will play in contributing to universal access to energy. In its recent Africa Energy Outlook, the International Energy Agency identifies the crucial role of off-grid solutions with a view to long-term integration of these solutions into the grid - this will require enabling conditions from a policy environment as well as finance (IEA, 2022).

The BGFA initiative, focussing on the latter, identifies the ability of companies providing such solutions to access capital as a key barrier. In this case, finance both improves the bankability of these projects and builds domestic capacity (via pilots to promote learning as well as domestic companies to provide services).

Learning from such pilot projects can serve as a guide for decision making for large scale deployment of renewable energy (Power Shift Africa, 2020).

Case 3: **Strengthen the bankability of projects** and **develop domestic financial institutions** – *InfraCredit*

InfraCredit is a private company established by the Nigerian Sovereign Investment Authority and provides local currency guarantees (IISD, 2020). The lack of local currency financing has been identified as a key barrier to support renewable energy projects (ARE, 2021). Local currency guarantees can help crowd in investment from long-term investors.

One of the key analytical elements that can help guide domestic financial initiatives is the availability of custom scenarios. An example is the interaction between Integrated Assessment Modelling (IAM) teams and central banks and other financial actors within the context of the "Network for Greening the Financial System" (NGFS, 2021). Within the context of this project, scenarios consistent with the temperature limit of the Paris Agreement are designed to be used by financial actors to perform risk assessments. Developing such scenarios for sub-Saharan African countries, and using these to guide financial decisions is a crucial research gap.

Types of finance

Another important dimension of finance is the type of finance provided (e.g., grants, concessional loans, public or private sector finance, blended finance, etc.). The relative importance of each of these types of finance depends on the relative maturity of the technologies/interventions.

Grants and concessional loans sourced from countries or multilateral institutions are crucial for pilot/demonstration projects, to expand electricity access, and to support the development of domestic green financial institutions. However, where there are demonstrated approaches that work in a domestic context, upscaling these interventions can also draw from commercial capital. With an eye to long-term sustainability, such grants and concessional loans can help unlock domestic capital sources (IRENA, 2022b).

Financial de-risking tools, such as guarantees and insurance mechanisms, are needed to attract investments and address some of the real and perceived risks (e.g., political risks, currency risks, force majeure) described above. However, an analysis of 17 key European financial instruments developed to support renewables in Africa found that such risk mitigation tools are lacking from many existing financial instruments (RES4Med&Africa, 2019).

The same study also found that existing instruments tend to support early business development and project preparation, but that few cover the later stages (e.g., negotiation, setting up a tender process).

Blended finance, where concessional public funds are combined with private funds, has already had some success in leveraging commercial finance for renewables in sub-Saharan Africa, and has significant potential to increase. This type of finance can enable renewable projects that currently lack access to capital, for example because of lack of credit history or inexperience among investors in renewable solutions, to compete with fossil fuel projects and crowd in commercial investments (Mutambatsere and de Vautibault, 2022).

Matching the sources of finances to the needs is very important given that adequate investments will be needed for Africa to meet its energy and climate goals. The IEA estimates that from 2026 to 2030, a yearly investment of over USD 190 billion representing 5% of global investment will be needed in Africa to meet its energy and climate goals (IEA, 2022).

Institutional capacity and policy design

Coordinated long-term energy sector planning is necessary to develop project pipelines, address grid infrastructure challenges, attract investment, and develop the necessary supply chains and professional training to enable a sustainable and just transition. This requires institutional capacity, knowledge and resources that are limited in many countries. While a number of countries in sub-Saharan Africa have put commitments, strategies and/or policies in place to foster renewables deployment - sending an important signal to investors on the future role for renewable technologies - a lack of institutional capacity means that project pipelines are still lacking and energy markets lack transparency and competitiveness.

In order to develop an adequate pipeline of financeable projects, substantial time, capacity and resources will be needed to support innovative technologies and business models and bring these to scale. For example, local capacities for undertaking feasibility assessments and developing an appropriate financing structure for renewable energy projects need to be strengthened. Existing readiness and concept development support from development finance institutions is often not sufficient (WE Forum, 2019), the result being continued reliance on consultants from abroad with more limited understanding of the local context. The *Alternative Financing for Municipal Embedded Generation* (AFMEG) project is an interesting example of an initiative to address capacity gaps in city administrations in South Africa in the sourcing of finance for municipal renewables projects.

Strong governance mechanisms, including adequate legal and regulatory frameworks, are also crucial for attracting capital, strengthening investor confidence and enabling transparent markets to drive cost reductions.

In many sub-Saharan African countries' utilities are government owned, meaning that **public procurement** will be an important mechanism for driving the uptake of renewables. Support for designing and creating competitive public procurement models (such as auctions and feed-in tariffs) could lead to more transparent and competitive markets, and can improve the efficiency of procurement processes. Ensuring that public procurement is an efficient intervention will require complementary reforms (see section *Institutional Barriers*).

Interventions such as the US Trade and Development Agency's *Global Procurement Initiative*, which supports public officials in Botswana, Ethiopia, and Kenya to develop competitive procurement models, could be explored, however, it is not clear if these are having a positive impact on countries' capacity. The Global Energy Transfer Feed-in Tariffs (GET FiT) programme is another example of a project that aims to build an enabling environment to incentivise private investment in renewable energy, with a focus on East Africa. The programme, which was started in Uganda by the Ugandan government, the Ugandan Electricity Regulatory Agency and KfW, tops up existing feed-in tariffs to make investments more attractive and builds local capacity, for example in tariff modelling and standardising PPAs.

Only about 14 countries in Africa have **feed-in tariffs**, and these have had limited success in delivering investment due to a weak regulatory environment. Feed-in tariffs have not been effective in some countries, for example, South Africa, where the feed-in tariff was abandoned and replaced by an auction scheme. **Auctions** have been more successful, with low auction prices indicating that they can deliver affordable electricity. (IRENA, 2022). Several sub-Saharan countries have adopted renewable energy auctions, at various stages of implementation, including Ethiopia, Ghana, Malawi, Mauritius, Namibia, South Africa, Uganda, Zambia and Mozambique. Despite delays, South Africa's Renewable Energy Independent Producers Procurement Programme (REIPPP) has been successful in procuring a total of 6.4 GW as of December 2021.

Reforming **fossil fuel subsidies** and redirecting funds to developing renewables will be important for enabling the transition to a renewable power system quickly, as well as for saving costs in the long run. Fossil fuel subsidy removal is often deeply controversial and politically challenging as many people can be dependent on subsidised fuels.

Therefore, subsidy reform requires strong governance, including effective planning and stakeholder engagement to ensure that reforms are economically and socially fair and accepted by civil society (UNDP, 2021). There are examples of countries in the region that are implementing subsidy reforms. For example, in 2016 Zambia removed subsidies from petroleum products (Bridle et al., 2019).

Regional cooperation

A key factor that will enable the reliability of clean energy systems in sub-Saharan Africa will be regional cooperation, through grid interconnection and power pools. As Sterl et al. show in a recent paper, there are a set of intersecting synergies in West Africa that provide guidance for creating a regional, renewable-energy dominated power system (Sterl et al., 2020).

Renewable energy resources are not uniformly distributed in the region due to geography and climatic zones. Thus, hydropower, wind and solar energy have differing seasonal characteristics. By matching wind and solar capacity to hydropower resources in individual locations, it is possible to optimise the use of hydropower to back up variable wind and solar resources on both a diurnal and a seasonal basis, while also taking into account additional sustainability criteria such as maintaining reservoir water levels.

One of the additional findings in scenarios for future renewable energy power in West Africa by Sterl, et al. is that a scenario with cross-border electricity trade leads to the most advantageous system both for penetration of renewable energy and for costs. In the case of West Africa, countries are already cooperating on an economic basis through ECOWAS (Economic Community of West African States), on energy issues through the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and have established a West African Power Pool (WAPP) that would serve as the basis for further expansion and integration of renewable energy.

In the context of the WAPP, Mali and Guinea are already being provided support for interconnectors (IEA, 2022). Apart from further support for such initiatives, support will also be necessary for policy alignment of technical standards to be harmonised across different countries (Taliotis et al., 2016).

Another example of a case where integrating variable renewables (solar and wind power) with hydropower can yield multiple benefits can be found in Eastern Africa. Analysis by Sterl and colleagues (Sterl et al., 2021) found that coupling the operation of the Grand Ethiopian Renaissance Dam (GERD) with solar and wind power could support a diversification of Ethiopia's power generation for domestic use as well as exports to the Eastern Africa Power Pool, while at the same time optimising the hydropower infrastructure use and prevent downstream negative environmental impacts.

Benefits of the transition

Transitioning sub-Saharan energy systems to renewable energy can generate benefits beyond reduced emissions. To maximise these benefits and mitigate potential impacts on communities dependent on fossil fuels and fossil fuel jobs, the transition must be managed to promote social and economic welfare, for example, through stakeholder consultation.

Many sub-Saharan countries have high levels of unemployment and high numbers of workers in the informal sector. Managed correctly, renewable energy development can create employment opportunities replacing and outweighing jobs lost from traditional energy (IRENA, 2022b). Solar alone has the potential to create about 3.3 million jobs by 2050 (IRENA, 2022b). For reference, around 7.5 million jobs were associated with the fossil fuel industry in sub-Saharan Africa in 2019 (see Figure 5.11 in (IRENA, 2022b)).

Data is scarce on what individual countries' renewable energy programmes have delivered in terms of jobs. For South Africa, one of the preferred countries for renewable energy investments in the region, analysis shows that its Renewable Energy Independent Power Producers Programme (REIPPPP) has, as of December 2021 created 63,291 job years (IPP Office, 2021). In 2021, the Nigerian government released a Green Jobs Assessment Report assessing climate measures in their NDC. In comparing a high renewables scenario to a high gas scenario, the report found the high renewables scenario resulted in significantly more jobs (ILO & UNDP, 2021).

The transition can also foster economic growth through various factors and policy instruments, such as increased investment, improved trade balances and lump sum payments for low-income groups. Analysis by IRENA (2022) found that Africa's GDP will on average be 6.4% higher from 2021 to 2050 under a 1.5°C pathway compared to current energy plans (IRENA, 2022b). The same analysis found a 1.5°C pathway could improve welfare 24.3% across various dimensions compared to current energy plans.

Transitioning away from fossil fuels, both for domestic use and export, would also come with further environmental, security benefits and health. Fossil fuel extraction has been a driver of conflict across sub-Saharan Africa (Gonzalez, 2010), and in many fossil fuel producing regions, pollution greatly impacts the health and livelihoods of host communities.

The WHO estimates that indoor air pollution is responsible for 490,000 premature deaths per year in sub-Saharan Africa (World Health Organization, 2018). These deaths could have been prevented if communities had access to clean energy in the form of renewables.

Risks of exploiting fossil fuels

Investing in new and/or expanding existing fossil fuel infrastructure will be costly for sub-Saharan Africa's development and economies and needs to be avoided. Today, Africa is only responsible for less than 3% of global energy-related carbon dioxide, although it has almost one-fifth of the global population (IEA, 2022). Fossil fuel investments will lock Africa into high emissions, result in stranded assets, and limit its economic opportunities.

Following Russia's illegal invasion of Ukraine and the subsequent energy crisis, European countries have turned to Africa for fossil gas. This has been justified by a narrative that it will improve energy access and stimulate economic activity. However, sub-Saharan African countries with a long history of relying on fossil fuel exports still have high levels of poverty. Bassey and Lemos (2022) show that in some cases these countries have had economic growth that is up to three times slower than those with more diverse economies.

This is not surprising, given the majority of revenues from new oil and gas production projects go to multinational companies instead of generating domestic economic growth – one study estimating this to be 66% (Oil Change International, 2021). To change this picture, the issue of ownership of energy projects would require the necessary attention, to increase ownership of renewable projects by SSA companies and local communities. Renewable energy projects allow for a variety of ownership models, and therefore provide an opportunity to increase local ownership.

New fossil fuel production is unlikely to increase domestic energy access and is not a sustainable path for Africa. Nigeria is a major oil and gas producer but still has the largest population in the world without access to electricity (IEA et al., 2022) and faces the most frequent and prolonged blackouts on the continent.

Ghana's power grid has seen a dramatic shift towards fossil gas. Its grid remains plagued by reliability issues and the country has been locked into deeply unfavourable "take-or-pay" agreements, paying an estimated 7% of the government budget in penalties to international oil companies.

With regards to oil and gas development, while governments may see this as an opportunity to export fossil fuels and generate revenues, studies have shown that developing gas and oil fields in Africa is about 15-20% more costly and up to 80% more carbon intensive than other fields globally. With the decline in capital pools for such projects, the costs of producing gas and oil is projected to increase, and as a result, become less competitive and not an attractive option (Leke et al., 2022).

Currently, about 40% of the gas produced in Africa is exported to Europe, China or India (Climate Action Tracker, 2022). Oil and gas export figures show an increasing trend of oil and gas exports abroad from sub-Saharan Africa (US EIA, 2020). As the world transitions to renewable energy, it is African host countries that will be saddled with debt and expensive fossil infrastructure if these companies pull out or the projects fail.

For example, Russia's illegal invasion of Ukraine has led to many countries accelerating deployment of renewable energy technologies - EU countries have increased their renewable energy ambition, from a 55% to 63% share of renewables in power generation, and we expect this momentum to continue (EMBER & CREA, 2022). This should be a sign to sub-Saharan African countries that current talks with European countries that want to access African fossil gas resources is a temporary transition measure. If sub-Saharan countries fall for this, they will remain trapped in infrastructure that will be a financial burden, and delay the deployment of renewables.

To put this into context, gas pipelines have a lifespan of several decades. Investing in new gas infrastructure, such as the Nigeria-Morocco Gas Pipeline, with the expectation that European gas demand will be strong in 2030 or even 2050, will leave sub-Saharan producers carrying the financial burden.

Pipeline of gas projects

Significant investment in fossil gas infrastructure is already planned across sub-Saharan Africa. About 38 GW of gas-fired power plants are proposed or under construction, more than double operating capacity as of January 2022 (Global Energy Monitor, 2022b). By comparison, about 8 GW each of solar and wind capacity has been announced, in development or under construction in the region as of May 2022 (Global Energy Monitor, 2022c, 2022d).

Plans to expand fossil gas, both for domestic use and export, also require substantial investment in gas transport and processing infrastructure. Even before Europe's attention turned to Africa's gas reserves following Russia's illegal invasion of Ukraine, a significant build-out of gas infrastructure was planned. Almost 20,000 km of gas pipeline in the region was proposed or under construction as of January 2022, which would be a more than 40% increase in existing pipeline length (Global Energy Monitor, 2022a).

At present sub-Saharan Africa supplies about 34 MtLNG/yr out of a total of approximately 400 Mt LNG/yr globally (Elliott, 2021). This could grow to about 60 MtLNG/yr by 2025. Industry sources estimate that the full pipeline through 2030 could add 74 MtLNG/yr. A summary of key fossil gas projects under development in sub-Saharan Africa is provided in Annex B.

Sub-Saharan countries analysed thus far under our 1.5°C National Pathway Explorer[7] all see gas in the power sector phased out at the latest by 2040 under 1.5°C compatible pathways, with most phasing out gas even sooner or not using gas to begin with (Climate Analytics, 2021a). This is generally accomplished with a rapid scale up of renewable energy generation and electrification of end-use sectors (buildings, transport, and industry) with significant international financial and technical support.

The current pipeline of gas projects in many sub-Saharan countries are not aligned with these benchmarks. For example, the capacity of proposed and under construction gas power plants in Nigeria is more than double current operating capacity. Further, over a fifth of this capacity isn't planned to be operational until at least the 2030s, with the proposed 1350 MW Abjua power station not expected to come online until 2037. Under analysed 1.5°C compatible pathways, Nigeria phases out fossil gas from the power sector between 2030 and 2040 (Climate Analytics, 2021a).

Green hydrogen in sub-Saharan Africa

Africa has the potential to produce green hydrogen, and export it to other countries, providing a new economic opportunity. The H_2ATLAS provides one analysis of this potential, which is currently available for West Africa (H2Atlas, 2022).

[7] Botswana, Cameroon, the Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Mozambique, Nigeria, Senegal, South Africa, and Tanzania

However, ramping up renewable electricity generation for green hydrogen export has to be seen in the context that still 52% of sub-Saharan Africa population does not have access to electricity (IEA et al., 2022). This will need to be prioritised for access and local economic development before excess generation and capacity could be directed towards producing green hydrogen for exports.

There are a few green hydrogen projects currently underway in the sub-Saharan region to unlock this potential, with some targeting the export market. However, international financial and technical support will be required for these to be realised. With support from United Nations Climate Change High-Level Champions, the Green Hydrogen Organisation, AfDB, and UNECA, the African Green Hydrogen Alliance was launched in May 2022 (founding members: Egypt, Kenya, Mauritania, Morocco, Namibia & South Africa) (IEA, 2022). The main aim of the alliance is to collaborate on the development of green hydrogen projects in the region. If the alliance plans are successful, Africa could become a key player in the development of green hydrogen and generate income needed for economic development.

The IEA estimates that green hydrogen could be produced for less than USD 2 per kilogram in 2030 in Africa, compared to less than USD 4/kg globally (IEA, 2022).A recent IRENA study on hydrogen globally indicates that sub-Saharan Africa has the greatest technical potential to produce green hydrogen at under $1.50 a kilogram by 2050 (IRENA, 2022d).

Beyond potential for export, green hydrogen could be used for fertiliser manufacture as well as an industrial energy source in the region. There are also important synergies recognised between renewable energy and hydrogen production, with hydrogen spurring a more rapid growth in renewable energy power and lower levelised costs, increasing the availability of renewable solutions for industry, providing flexibility for electricity grids and in appropriate circumstances providing storage capabilities (IRENA, 2019).

Repurposing existing gas infrastructure for hydrogen

A summary report, reviewing more than 20 studies, on the technical possibilities for repurposing existing gas infrastructure to hydrogen was compiled by the EU Agency for the Cooperation of Energy Regulators (ACER, 2021). Concerning technical feasibility, the review indicates that existing pipelines can be converted. Salt caverns, which formerly stored fossil gas, are particularly suited for hydrogen storage. However, the repurposing of compressor stations is assessed as being related to challenges.

The summary report also investigates the cost of repurposing. In general, the report finds that the repurposing is both feasible and cheaper than starting from scratch. However, while the repurposing of existing gas infrastructure to transport green hydrogen can be cheaper, the construction of new gas infrastructure, even with the option to repurpose it for hydrogen later, is associated with the serious risk of becoming a stranded asset (Climate Action Tracker, 2022).

In sub-Saharan Africa there are very limited opportunities for repurposing existing natural gas pipelines. Building new natural gas pipelines in sub-Saharan Africa would likely be associated with new fossil gas developments that would have a significant risk of becoming stranded. As the International Energy Agency noted in its 2022 Africa Outlook "New long lead time gas projects risk failing to recover their upfront costs if the world is successful in bringing down gas demand in line with reaching net zero emissions by mid-century".

Potential risks

The barriers mentioned above for the expansion of renewable energy in sub-Saharan Africa pose an equal risk to the production of green hydrogen.

Furthermore, to ensure that green hydrogen production does not negatively impact domestic use of renewable energy, sub-Saharan African countries will need to develop carefully formulated frameworks that ensure electrolysers are operated on "surplus" electricity only. Simply put, this should translate into local households being supplied with electricity first while electrolysers are the last in line to be supplied and get the "leftover" electricity.[8]

Given water scarcity in the region, it must be noted that not all SSA countries could produce green hydrogen. Seawater desalination plants, requiring additional amounts of renewable electricity, will need to be built as part of the electrolysis process. This would avoid possible competition for freshwater resources.[9] In the IPCC's Sixth Assessment report, it is even noted that an increasing share of renewables, in connection with desalination, has the potential to improve the water balance in the region (Denton & Halsnæs, 2022). The current members of the African Green Hydrogen Alliance are

[8] The operation of electrolysers on surplus electricity can still be a lucrative business case.
[9] See Civil Society perspectives on Green Hydrogen production and power-to-X products in Africa https://www.germanwatch.org/sites/default/files/positionpaper_greenhydrogenproductionandpower-to-x_productsinafrica_250122.pdf

countries that border the sea (Namibia, Morocco, Mauritania, Kenya, South Africa), and will have easy access to seawater.

Overall, the development of green hydrogen needs to be managed in a way that benefits the local communities first before supplying export markets. The decentralised nature of renewable electricity generation could lead in parts of the supply chain to a different, more positive dynamic than the one experienced with fossil fuels. The ownership/operation of the centralised elements of the supply chain, as for example the domestic and international transportation of the fuel, would need to be carefully regulated.

Regional outlook

West Africa

West Africa has the largest economy in sub-Saharan Africa. It is by far the largest fossil gas producing and exporting region with Nigeria alone accounting for 62% and 65%, respectively, in 2019 (US EIA, 2020). Remaining West African gas producers (Côte d'Ivoire, Ghana and Senegal) only account for 6% of sub-Saharan gas production; however, significant gas development is planned in Senegal for export and domestic use. Despite current supply challenges, Nigeria is also aiming to expand gas production and export with several large infrastructure projects, such as the NLNG Train 7 project and the Nigeria-Morocco Gas Pipeline.

West Africa's electricity access rate was 53% in 2019, though this varies widely by country (IRENA, 2022b). Cabo Verde and Ghana have the highest electricity access rates in the sub-region at 96% and 84%, respectively, in 2019, while Niger and Burkina Faso both had access rates around 20% in 2019. Nigeria's access rate is around the regional average at 55%; however, as the most populous country in the region, this translates to around 90 million people without access, the largest deficit in the world. West Africa also has the second lowest clean cooking access rate in sub-Saharan Africa at just 13% in 2019, though this also varies by country.

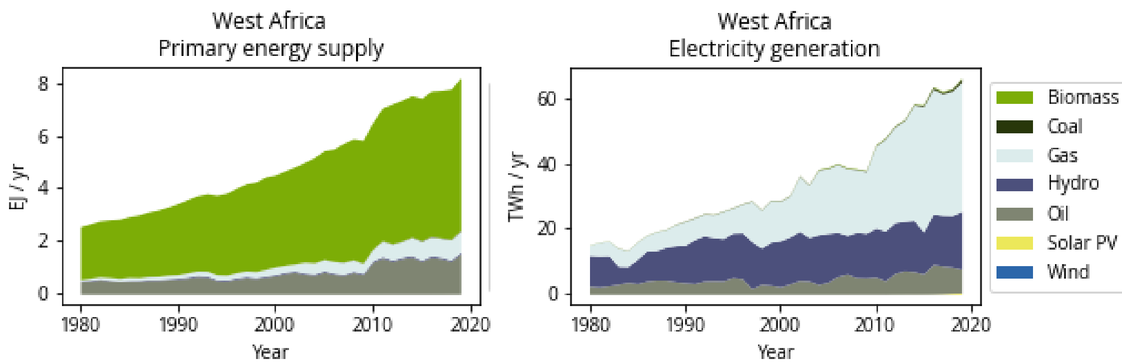

Figure 2: West African primary energy supply and electricity generation from 1980 to 2020. Source: IEA World Balances (2021)

Currently, hydropower is the region's largest renewable energy source for power generation at just over 30% in 2019; however, West Africa also has high potential for solar and wind. IRENA estimates the region has a technical installable capacity of 1956 GW for solar and 106 GW for wind assuming a 1% land-utilisation factor (IRENA, 2022b). Hydropower potential is estimated to be 162 GW.

East Africa

Like West Africa, East Africa has a large discrepancy in populations with electricity access and populations with access to clean cooking. While 46% of East Africans have access to electricity, only 7% have access to clean cooking, the lowest access rate across the subregions, though this also varies by country (IRENA, 2022b).

Many countries have seen significant increases in electricity access. Kenya's access rate, for example, increased from just over 40% in 2015 to over 70% in 2020 (World Bank, 2022a). Over this period, Kenya implemented their Last Mile Connectivity project installing new transformers and the extending low voltage network (Kenya Power, n.d.).

Progress towards higher access to clean cooking in the region has been slower, resulting in persistent reliance on biomass in primary energy (see Figure 3).

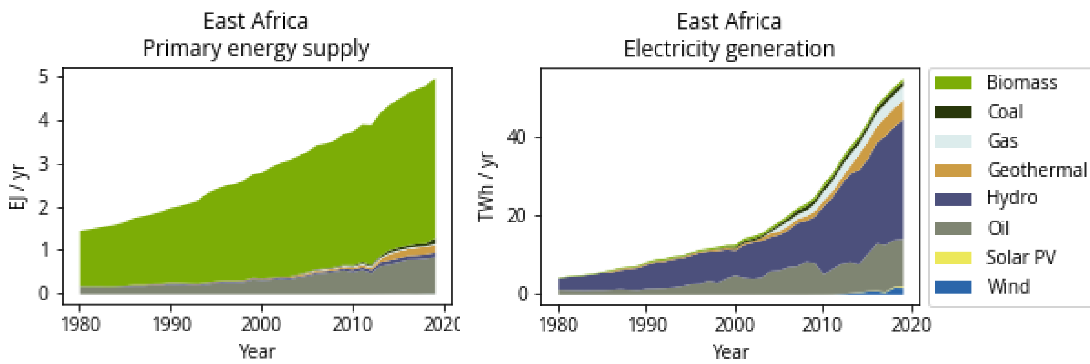

Figure 3: East African primary energy supply and electricity generation from 1980 to 2020. Source: IEA World Balances (2021)

In the power sector, the region has made use of its abundant hydroelectric resources, accounting for over half of the region's power generation in 2019 (see Figure 3). Additionally, East Africa has the highest share of non-hydropower renewable power generation of the four subregions with 9% from geothermal power, 3% from wind and 1% from both bioenergy and solar (IEA, 2022). However, this is largely concentrated in a few mature markets like Kenya and Ethiopia while several other countries remain reliant on oil, such as the Comoros, Djibouti, and South Sudan.

While natural gas use in East Africa has historically been very low (with the exception of Tanzania), Tanzania has plans to develop more gas projects - with most expected to come online in the coming years and supply domestic markets.

Central Africa

Central Africa is the smallest energy market of the four subregions: while it has about the same population size as Southern Africa, it has about one-third the primary energy supply. The region has very low energy access, with 36% of the population with access to electricity and 17% with access to clean cooking (IRENA, 2022b). As with East and West Africa, this results in a high reliance on biomass.

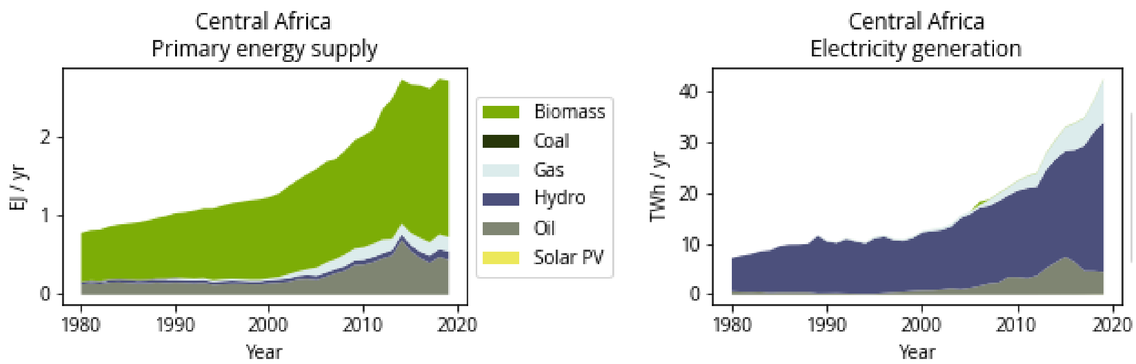

Figure 4: Central African primary energy supply and electricity generation from 1980 to 2020. Source: IEA World Balances (2021)

Central Africa's power sector is largely supplied by hydropower, accounting for about 70% of the power supply (see Figure 4). Central Africa has very low utilisation of other non-hydropower renewables, with negligible (<1%) power generation from solar PV and bioenergy. The region has high potential for solar (particularly in Angola) and further hydropower capacity (IRENA, 2022b). Wind power has a lower potential, but could be feasible in Angola and Chad.

Southern Africa

Southern Africa has the highest GDP per capita of the four subregions; however, this and many other variables are highly skewed by South Africa, a significant outlier in the region. South Africa accounts for almost three-quarters of Southern Africa's primary energy supply and over three-quarters of generation capacity (IRENA, 2022b). As with the other regions, access to energy varies drastically by country. South Africa has the highest energy access rates in the region, 84% for electricity and 87% for clean cooking, while access rates remain much lower for other countries such as Malawi, Madagascar and Mozambique (IRENA, 2022b; World Bank 2022a, 2022b).

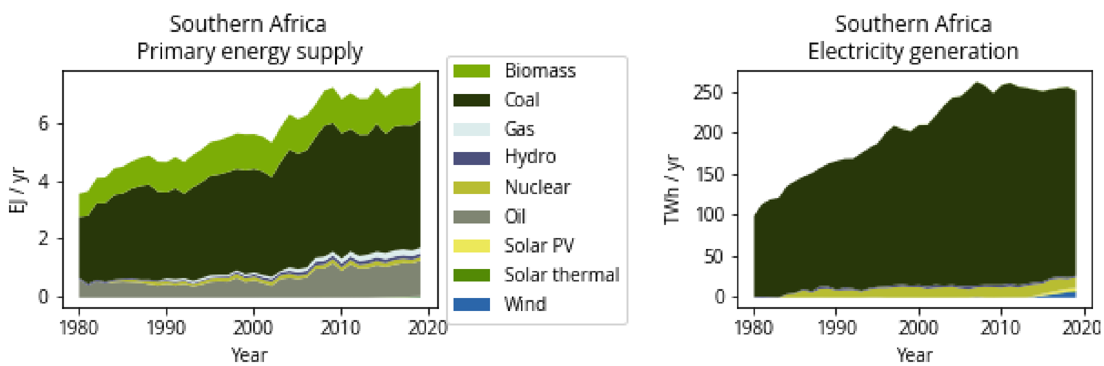

Figure 5 Southern African primary energy supply and electricity generation from 1980 to 2020. Source: IEA World Balances (2021)

Unlike other subregions, Southern Africa relies much less on biomass and much more on coal. This is again largely skewed by South Africa, although Botswana and Zimbabwe also have a high share of coal in their power generation. Other countries in the region have much more decarbonised power systems. For example, Lesotho is essentially 100% powered by hydropower, Eswatini is mostly powered by bioenergy and hydropower, and Namibia has a more than 20% share of solar power in their electricity mix (IRENA, 2022b).

While Mozambique is currently a minor fossil gas producer, plans to develop gas discoveries in the deep-water Rovuma Basin could position Mozambique as a major LNG exporter.

Southern Africa has the second largest pipeline of gas-fired power plant projects, behind West Africa, mostly in South Africa and Mozambique (Global Energy Monitor, 2022b).

Conclusion and recommendations

Sub-Saharan Africa's multiple crises will not be solved without addressing energy needs. In order to grow economies and fight poverty, sub-Saharan countries will need to increase energy access. Renewable energy (wind and solar in particular) can provide an affordable way of achieving these goals.

While sub-Saharan Africa has huge renewable energy potential, it will need enhanced international support to unlock it. This would require removing barriers to scaling up renewables, and implementing targeted interventions that will build country-level institutional capacity to ensure continuation of projects when support is withdrawn.

Various support initiatives have already been put in place, but the extent to which these have been effective needs to be assessed in order to focus the support on those that are relevant to the local context and have had the biggest impact.

Without investment, both public and private, poverty levels will continue to grow, and fossil fuels will continue to dominate energy mixes of most sub-Saharan countries. Continued fossil fuel use risks limiting countries’ economic growth, and missing opportunities and socio-economic benefits that come with the deployment of renewable energy. Strong and improved governance mechanisms will be necessary in enabling the flow of funds, and other forms of support.

There are clear renewable energy success stories in sub-Saharan Africa, and countries could scale up and implement those that have demonstrated a positive impact on communities. In order to avoid wasting already stretched resources, it is important that as programmes and projects are being developed by various actors, they do not duplicate what already exists, and also avoid implementing projects that are not suitable for sub-Saharan countries.

Also important is the issue of ownership and leadership by sub-Saharan African countries. If renewable energy projects are going to follow a similar path as that of fossil fuels, where the majority of projects are owned by foreign organisations, energy access and economic development will continue to remain a challenge for the region. The only way to make sure revenues generated from these projects contributes to economic growth, to benefit sub-Saharan African countries and local communities, is by ensuring projects are owned by sub-Saharan African companies.

The case for a sub-Saharan Africa energy transition support deal

Clean energy will be at the heart of development prospects for the region and critical to overcoming poverty, delivering clean and affordable energy to those that do not have it, to powering industry in sub-Saharan Africa and in the longer term, protecting the environment. Approaches to supporting the rollout of renewable energy need to take into account these four broader needs to support sustainable development. To achieve these, there is a need to ensure policies that create an enabling environment are coordinated at the regional and national levels, with support from the international community.

The preceding discussion shows that it is clear that many of the measures discussed have been tried and even supported at scale over the years, but have yet to produce the transformations needed. This does not mean that they will not succeed in the long run if continued support is present, but rather suggests a need to scale them up, while at the same time monitoring where gaps remain.

It is also clear that there are a lot of open questions around the way in which policies have worked, or not, and what can be done to make them more efficient and more universal in the future.

A major lesson from this review is that all countries are different in the region, and some countries have had a lot more success than others. There is a lot to be learnt from these different contexts to identify which solutions work best in different situations.

Some of the key elements that have been identified include:

- There is a need for specific ambitious national and regional commitments for renewable energy deployment, as well as support from regional centres to implement these.
- Sub-Saharan African countries continue to need support in developing and strengthening institutional capacities. Building capacity across all levels, from the local/city level to national level, can help embed knowledge in local institutions and bring innovative business models and technologies to scale.
  While progress has been made in recent years, there is still some way to go. Areas that require particular focus include:
  - policy and regulatory design, including designing fossil fuel subsidy reforms and developing competitive public procurement models;
  - developing appropriate financing structures for renewable projects and fostering and supporting innovative business models;
  - strengthening regional initiatives and institutions, to ensure coherence and build synergies.
- Support is needed for long-term energy system planning and market design, to facilitate the development of infrastructure, supply chains, training programmes and energy markets that can support a high penetration of renewables. This is needed to improve the bankability of projects and long-term sustainability of renewable energy markets in sub-Saharan Africa, as well as to foster increased private sector engagement.
- Measures need to be put in place that eliminate market distortions in favour of fossil fuels. These should be introduced in such a way as to avoid exacerbating energy poverty and energy access issues.
- Unlocking and increasing private and public sector finance requires the de-risking of renewable investments, the development of innovative financial instruments, and increased international support for implementing these recommendations.
- Support is needed to implement measures to improve energy efficiency in buildings, appliances, industry and transport. Efficiency in all of these areas is very important for environmental sustainability and affordability. Inefficient buildings, appliances and industry will require more energy which will be more costly, and given the rapid growth in the region this could become a very large problem in the future.
- An improved availability of granular, open-access data can allow policy decisions to be data-driven, and facilitate transparency and accountability. This can also facilitate awareness raising among citizens on the benefits and the need to take up renewable energy technologies.

In short, there is a window of opportunity now to build on the positives in the region, including the recent rapid growth rates and installed renewable capacity, but this will require holistic and packaged approaches to build on what has been achieved to date and extend it to more countries.

Proposed interventions should aim to reduce fragmentation and build synergies with existing initiatives in a way that adds value, avoids duplication and ensures coherence. Additionally, a detailed mapping of all existing renewable energy initiatives in SSA will be important to assess gaps and value add opportunities.

Further work needed

In addition to detailed analyses of areas covered in this report, the following would also require further investigation:

- Comprehensive assessment of enabling conditions for green hydrogen production in sub-Saharan African countries (for both domestic use and exports). This should include the evaluation of potential risks of producing green hydrogen in countries with low levels of energy access, and possible conflict with freshwater access by local communities, as well as an evaluation of the economic feasibility of exporting green hydrogen from Africa to Europe.
- Understanding land availability for wind and solar PV, using land cover and weather data, and determining areas in those regions that are suitable, for example, for the development of wind turbines. The technical potential should be combined with an analysis of the IPCC AR6 1.5°C compatible scenarios that will help understand the economic potential of upscaling renewables in the region.
- Analysis of the country-level finance and investment requirements for renewable energy deployment in various sectors across sub-Saharan Africa, and identification of appropriate financial instruments for meeting these needs.
- Comprehensive and in-depth analysis of individual country-level programmes and energy projects pipeline in sub-Saharan Africa. This will need to investigate country-level barriers to scaling up renewables, and make specific recommendations on how to address them in order to enable the support necessary to unlock renewables investments in the region.
- Assessment of renewable energy ownership models that could be applied to sub-Saharan Africa and contribute to economic development.
- There are data gaps in renewable energy financing in Africa. This is an area that requires attention to enable the tracking and monitoring of scale and sources of finance invested in renewable energy projects in sub-Saharan countries.

Annex A: Key finance institutions

Key institutions	Categories	Organisation	Energy policy	
			Fossil fuels	**Renewable energy**
	Multilateral Development Banks (MDBs) and Development Finance Institutions (DFIs)	**African Development Bank (AfDB)**	No oil and gas exploration, but support for gas production and generation. This is stated in their energy sector policy. *Project examples:* • Enabling large scale gas and power investments in Mozambique	Funding RE and green hydrogen *Project examples:* • Desert to Power initiative focuses on regional scale development of solar generation through decentralised energy projects in the Sahel region. Goal of 10,000 MW of new solar generation capacity by 2030 • Sustainable energy fund for Africa is a multi-donor fund for renewables and energy efficiency, which mainly provides technical assistance and finance instruments

				• In partnership with GOPA-International Energy Consultants on potential of green hydrogen development in Africa - 3 countries Egypt, Ghana & Kenya
		World Bank (incl International Finance Corporation (IFC)	Announced in 2019 to stop financing thermal coal and upstream oil and gas. But upstream gas will be funded if urgently needed, especially in poorer country for energy accessibility.	Support investments in RE and energy efficiency. *Project examples* • IFC - World Bank Lighting Africa program is focused on supporting the acceleration of markets in Sub Saharan Africa for off grid solar lighting
		French Development Agency (AFD)	Its low carbon plan indicates no funding for coal or oil/diesel power plants; exploration, production or exclusive transport of coal, gas or oil. However, gas power plants, flaring and	In the low carbon plan, commitment is made to support power generation based on renewables. Project example • Green microfinance

			domestic cooking/heating can be financed to "increase access" in Africa *Project examples* • Expansion of fossil gas supply network into households • Also supports hybrid energy transition projects eg the development of hybrid mini-grids	programme: In Cambodia, AFD finances the development of high-quality individual solar kits in partnership with the local private sector.
		New Development Bank (NDB)	No new coal for power generation No mention of gas funding/restrictions	Prioritises "clean" and RE projects. The Bank´s 2022 to 2026 strategy commits to having 40% of approved projects that contribute to climate mitigation and adaptation including energy transition. *Project examples*: • Battery energy storage in South Africa is helping South Africa to store excess renewable energy for peak times.
		US	DFC will improve access	DFC announced in

		international development finance corporation (DFC)	to essential services such as energy, investments in fossil-fuel infrastructure when its considered critical eg: Sierra Leone's first fossil gas power plant. LPG for USAID/Malawi	2021 that it will ramp up support for RE and energy efficiency projects. Project examples • Renewable Energy in Senegal - construction of 158 MW wind power plant northeast of Dakar to help solve electricity shortages in Senegal.
		European Development Finance Institutions (EDFI)	In 2020 EDFI Statement on Climate and Energy Finance, EDFI member institutions ceased new coal or fuel oil financing and will limit other fossil fuels, such as selective investments in gas-fired power generation, to financing consistent with the objectives of the Paris Agreement (EDFI, 2020).	In 2020 EDFI Statement on Climate and Energy Finance, EDFI members committed to "align all new financing with the objectives of the Paris Agreement by 2022 and will transition [their] investment portfolios to net- zero GHG emissions by 2050 at the latest" including through support for access to green energy and just transitions.
		African Export-Import Bank	Afreximbank has signed an MOU with African Petroleum Producers Organisation to establish the African Energy Transition Bank that will ensure predictable allocation of finance to	*Project examples* • The Bank is "cooperating with Aenergy to develop a low carbon sustainable

			fossil fuel and RE projects. *Project examples* • Eco-Gas B.V (Ecowgas), LNG distribution infrastructure platform in West Africa to promote access to "cheaper" and "cleaner" fuels.	economy and a climate finance strategy to support projects and national initiatives" including support for renewable energy (African Export-Import Bank, 2018)
	Regional organisations	**African Union (AU)**	The African Energy Commision (AFREC) is the Agency under the African Union responsible for harmonising and coordinating energy policies. AFREC´s strategy energy includes RE and oil and gas programmes. The main aim of the oil and gas programme is to promote the expansion of refinery capacity and fossil infrastructure.	AU launched Sustainable Energy for All (SE4ALL) initiative in 2011. Financed mainly by the AfDB, & supported by UNDP, the aim is access and doubling RE by 2030. AU launched the African Renewable Energy initiative (**AREI**) whose objective is to have 10 GW of additional RE generation capacity across Africa by 2020 ; a minimum of 300 GW by 2030.
		United Nations Economic Commission for Africa (ECA)	ECA is assisting African countries and Regional Economic Communities (RECs) in the implementation of new technology - pragmatic investment in "less polluting" fossil-fuel such as natural gas	Accelerating clean energy investments for access and climate ambition in Africa (SDG7 initiative for Africa, an initiative based on three pillars: sustainability, governance and

				finance) ECA is one of the supporters of African Green hydrogen alliance
		ECOWAS	The ECOWAS renewable energy policy is committed to reduce dependence on imported fossil-fuels and exposure to volatile hydrocarbons international markets and thus have a positive impact on regional trade balance.	Established the ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE) to coordinate and/or implement RE & energy efficiency
	Others	**China**	China development bank is the largest financier of FF projects and companies in Africa. China is the biggest investor in the sub-Saharan electricity sector. China **Export-Import bank** is the main investor (Lema et al, 2021)	• Majority (56%) of funded energy generation projects "use" sources of renewable energy *Project examples*: • Fourth generating unit of hydropower project in Guinea completed in 2021. The unit is expected to generate up to 2,016 billion kWh of electricity annually.
		USA	Have announced intention to end overseas finance for "carbon-intensive fossil fuel based energy" but have not acted on this or	Project examples • USAID - SURE programme (Scaling up for

			provided a clear plan USAID- Power Africa - Addressing impediments of 60 gas projects in 17 countries with a new potential generation capacity of over 17,000 MW	renewable energy) that supported 31 countries • USAID- Power Africa - 30,000 MW of cleaner, more reliable electricity generation capacity alongside of 60 million new home and business connections by 2030
		EU		• Several EU-Africa partnerships that aim at providing clean energy, eg Africa-EU Energy Partnership (AEEP)
		IRENA		Africa Clean Energy Corridor- accelerates development of renewable energy potential and cross border trade of renewable power with adequate zoning and resource assessment to site renewable power plants with high resource potential.

Annex B: Key upcoming gas projects

Country	Project name	Category	Status - Description
Nigeria	Nigeria LNG Train 7	Processing	[Proposed] – Additional 4.2 mtpa LNG processing capacity.
Nigeria to Morocco/ Spain	Nigeria-Morocco Gas Pipeline	Pipeline	[Proposed] – Apparent extension of the West African Gas Pipeline to end in Morocco and Spain. In competition with Trans-Saharan Gas Pipeline.
Nigeria to Algeria	Trans-Saharan Gas Pipeline	Pipeline	[Proposed] – Extension of the under construction Trans Nigeria Gas Pipeline to bring Nigerian gas to Algeria for export to Europe. Project development restarted in February 2022.
Senegal/ Mauritania	Greater Tortue Ahmeyim (GTA) Gas Complex	Production	[In development] – About 425,000 million m^3 of gas reserves.

			Expected online in 2023.
Senegal/ Mauritania	[GTA FLNG Terminal]	Processing	[Construction/Proposed] – Floating LNG terminal for export. Phase 1 (2.5 mtpa) is under construction and Phase 2 (7.5 mtpa) is proposed.
Tanzania	[Tanzania LNG Terminal]	Processing	[Proposed] – Expected online in 2027. LNG processing capacity of 10 mtpa.
Mozambique	[Mozambique LNG Terminal]	Processing	[Under construction/shelved] - Four LNG trains with capacities of 5 mtpa each, with the possibility of ten trains in the future. Two trains were under construction but development has been paused due to security threats
Mozambique	[Coral South FLNG Terminal]	Processing	[Under construction] - Floating LNG terminal with capacity of 3.4

			mpta. Expected online in 2022.
Mozambique	Rovuma LNG Terminal	Processing	[Proposed] - 15.2 mtpa capacity LNG terminal expected online in 2025.
Mozambique	Matola FRSU Terminal	Processing	[Proposed] - Floating storage and regasification unit expected online in 2025. Imported gas is expected to be sent to South Africa via the Rompco Pipeline
Mozambique to South Africa	African Renaissance Gas Pipeline	Pipeline	[Proposed] - Pipeline to connect new production in the Romuva Basin in Mozambique to South Africa. Sasol has exited from the project in favour of tanker LNG
Cameroon	Cameroon LNG Terminal Phase 2	Processing	[Proposed] - Phase 2 of the Cameroon LNG Terminal includes a fourth LNG train (6.75 mtpa) expected online in 2026

Equatorial Guinea	Fortuna FLNG Terminal	Processing	[Proposed] - The project was originally cancelled by re-proposed in March 2022.
Republic of Congo	Congo FLNG Terminal	Processing	[Proposed] - 1.4 mtpa capacity floating LNG terminal expected online in 2023 for domestic use and export

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