Energy and Economic Growth
Applied Research Programme

Unlocking private investment in renewable power in Sub-Saharan Africa

Briefing Note

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Acknowledgements

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EEG will commission rigorous research exploring the links between energy, economic growth and poverty reduction in low-income countries. This evidence will be specifically geared to meet the needs of decision makers and enable the development of large-scale energy systems that support sustainable, inclusive growth in low income countries in South Asia and SSA.

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1 Introduction

With burgeoning urban populations and growing economies, Sub-Saharan Africa's electricity needs are growing. Supply has failed to keep up. In 2011, the World Bank estimated that Sub-Saharan Africa must add 8 GW of generation capacity annually through 2015, but in the last decade, the region averaged only 1-2 GW.[1] Chronic load shedding has ensued, constraining economic growth.[2] The International Energy Agency (IEA) projects that total generation in the region must more than double by 2030 to meet demand. Outside of South Africa, it must triple.

Renewable energy is central to the equation. Sub-Saharan Africa is endowed with a wealth of renewable resources. Its river systems, bioenergy, sunshine and wind could meet the region's current and future electricity needs.[3,4] Hydropower already generates 22% of Sub-Saharan Africa's electricity. However, wind, solar, biomass and geothermal collectively contribute only 1%.[5]

The cost of renewable power has declined dramatically in recent years (aside from hydropower, an already advanced technology). The cost of electricity from wind, biomass, geothermal, hydro, and solar PV is now at, or below, grid parity with conventional fossil fuel power plants throughout much of the world. In South Africa, for example, wind and solar PV are already the cheapest sources of grid-connected energy. The cost of non-hydro renewables is projected to continue to fall. McKinsey & Co. projects that by 2030 solar will be the cheapest or second cheapest domestic energy source in most Sub-Saharan African countries.[6]

Renewable technologies' competitiveness derives from falling equipment costs and their low operating costs – unlike thermal generation, it does not require a continuous supply of fuel. Most of their costs are upfront.

Given renewable technologies' relatively high capital costs, the availability and affordability of finance affects their economic attractiveness. In developing countries, finance tends to be scarce and interest rates high due to a variety of factors, including political and currency risk, causing the cost of renewables in Africa to be somewhat higher than the global average frontier solar and wind energy markets in Latin America and the Middle East.

This briefing note explores the steps needed to unlock investment in renewable power. It focuses on Sub-Saharan Africa, but its lessons are broadly applicable. The briefing note draws on and complements two State-of-Knowledge Papers produced by the Applied Research Programme on Energy and Economic Growth (EEG):

- Wolak, F. & Strbac, G. 2017. Electricity Market Design and Renewables Integration in Developing Countries.
- Woodman, B, Mitchell, C. & Ragwitz, M. 2017. Economic and Non-Economic Barriers and Drivers for the Uptake of Renewables.

These papers reviewed the literature and evidence available on each topic, and identified key research questions and knowledge gaps for the EEG research programme to explore.

The following section explores the projected renewable energy investment requirements in the region. Section 3 introduces an enabling environment for renewable power, with sections covering best practice power sector planning, grid design and interconnection, a regulatory framework for independent power producers (IPPs), independent regulation, competitive procurement and finance and risk mitigation. Illustrative cases are provided where Sub-Saharan African nations have succeeded in scaling up renewable energy generation. Section 4 concludes with key outcomes for the EEG research programme.

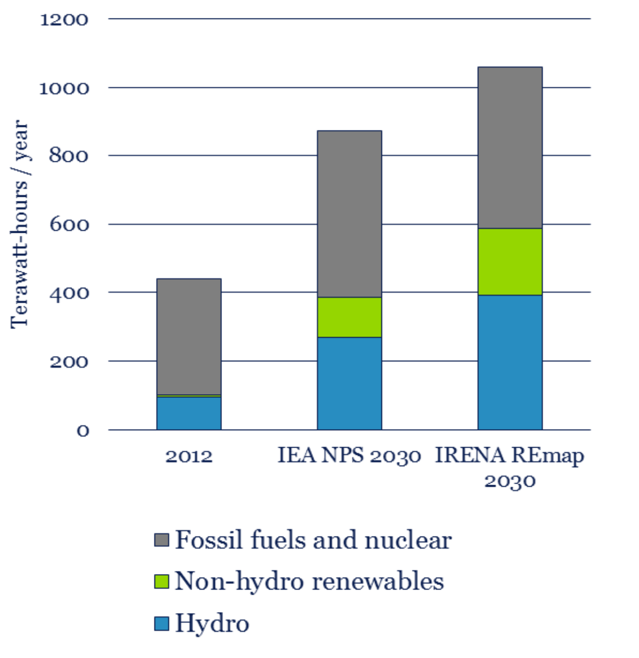
2 Renewable energy investment needs

Renewables are making headway in a number of Sub-Saharan countries. The IEA and International Renewable Energy Agency's (IRENA) expect this trend to accelerate (Figure 1):

- **IEA's New Policy Scenario** (NPS) – based on existing policies, supply, demand and investment trends – sees renewable energy's share of Sub-Saharan Africa's generated electricity increase from 22% to 40% by 2030, with non-hydro renewables contributing 12%.

- **IRENA REmap 2030** is more ambitious. Renewable energy contributes 58% of Sub-Saharan Africa's electricity mix by 2030, with non-hydro renewables contributing 23%.[8]

Figure 1. Projected growth in Sub-Saharan African electricity generation, 2012-2030[7]



Underpinning both scenarios is a dramatic increase in investment. The IEA's NPS sees roughly US$586 billion invested in new power infrastructure from 2015-30 (Figure 2). At US$39 billion per year, this figure represents a nearly five-fold increase on current annual spending.[9]

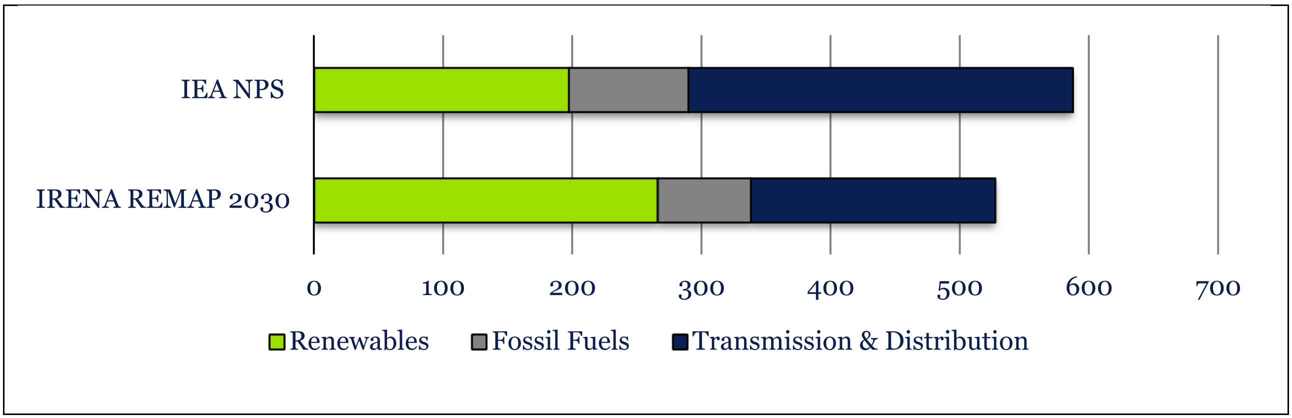
The lion's share of investment is needed for renewable generation and transmission and distribution (T&D):

- **IEA NPS**: 35% of projected investment is for scaling up renewable energy. Only 16% is for thermal generation. Half is for expanding T&D networks.

- **REmap 2030**: 50% of investment is for renewable energy. Interestingly, overall investment needs are less than in IEA NPS due to lower T&D requirements.

Public finance alone will not be sufficient to close this spending gap. As discussed in the following section, both public and private finance will be essential.

Figure 2. Investment needs in Sub-Saharan power sector to 2030 (US$ billion)[10]


IEA NPS
IRENA REMAP 2030
0
100
200
300
400
500
600
700
Renewables
Fossil Fuels
Transmission & Distribution

3 An enabling environment for renewables

Renewable energy potential is substantial across Africa, but the enabling environment varies. Enabling factors for renewables are outlined in Figure 3. Each of these enabling factors is discussed below, with a particular emphasis on those in green: procurement mechanisms and finance & risk mitigation.

3.1. Power sector planning

A power sector plan is critical for assessing individual projects against a country's needs. Planning involves accurately projecting future demand and identifying options to meet it through expanded generation, demand management or trade. Long-term targets for renewables can also signal to developers, stimulating a pipeline of investible renewable projects.

Figure 3. Enabling environment for renewables

3.2. Grid design & interconnection

In traditional power systems, large-scale central power plants provide a continuous, uni-directional supply of electricity. Renewable power plants, in contrast, tend to be relatively small and decentralised. Some renewable resources are 'intermittent', for example, only supplying electricity on windy or sunny days. Hydropower supply varies by season. Power systems based on a renewable supply, therefore, must be sophisticated. They must enable bi-directional flow patterns on T&D networks and take steps to balance mismatches between supply and demand. These steps could include:

- **Responsive and flexible generation**, like hydropower, pumped storage, geothermal, natural gas and concentrated solar power can be turned off and on to back up intermittent renewables.
- **Energy storage**, which is on the cusp of competitiveness, can smooth supply over time.
- **Interconnection** of geographically dispersed sources can smooth supply over space.
- **Demand response** technologies and practices can shift the timing of electricity consumption to when supply is greatest.

Grid interconnection is also needed to get renewable energy to market, as large hydro and wind resources in Africa are distant from markets. Transboundary electricity trade is currently low, but the West African Power Transmission Corridor is under construction, and an 'Africa Clean Energy Corridor' is planned from Egypt to South Africa.

3.3. Independent power producers

Most Sub-Saharan nations have vertically integrated power systems, i.e. state-owned utilities provide both electricity generation and T&D. Opening the door to private participation in power supply is a first step to accelerating investment in renewable energy. National utilities often lack prior experience with renewable energy, aside from hydropower, and tend to default to familiar forms of generation. Private participation in the power sector can bring in much needed finance and harness the expertise of international renewable energy developers and investors (see Section 3.6).

IPPs can be incorporated alongside state-owned generation or in a fully unbundled and competitive power sector. Importantly, private participation will not negate government planning and oversight. In fact, IPPs rely on it. Absent strong public institutions and trained public workforces, private participation in the power sector risks higher fees, protracted tendering and inflexible long-term contracts.[11,12] Transparent and standardised procedures for power project planning, selection and procurement can reduce risks and cost overruns.

3.4. Independent regulation

Political influence in power sectors frequently leads to cronyism, mismanagement and tariffs below cost recovery levels, all in efforts to secure political support. Utilities, as a result, run large deficits limiting their own creditworthiness and investment, and undermining their credibility as offtakers for IPPs.[13] An independent regulator, removed from political influence, can encourage investment in power sectors by providing transparent and predictable decisions around market access and tariffs.

3.5. Competitive procurement mechanisms

A power purchase agreement (PPA) is the central contract between an IPP and offtaker, typically a state-owned utility. It defines the tariff structure, purchase obligations and duration in which an IPP will feed electricity into the grid. PPAs are long-term contracts, typically 15 to 30 years.[14] Given the duration and magnitude of PPAs, it is essential that they create the durability and predictability necessary for a long-term business venture, whilst reflecting the cost of production and preventing windfall profits at the expense of consumer or taxpayer.

Generally speaking, three approaches are used in Sub-Saharan Africa to procure privately produced power:

- **Direct negotiation** between an IPP and utility, in which a PPA emerges from a solicited or unsolicited proposal for a new power plant.
- **Feed-in tariffs,** commonly used to attract investment in renewable electricity, in which IPPs are guaranteed a standard PPA at a fixed, often subsidised rate.[15]
- **Competitive tenders or auctions,** in which IPPs bid to supply a pre-determined quantity of power at the lowest tariff. The winner is awarded a long-term PPA for a new power plant.

In Sub-Saharan Africa, 70% of capacity procured from IPPs has emerged from unsolicited proposals and directly negotiated PPAs.[16] However, competitive tenders are proving to have the best investment and price outcomes.

Auctions enable more rapid price discovery than directly negotiated PPAs or feed-in tariffs, preventing utilities from locking themselves into long-term over-priced contracts. This downward pressure on prices is particularly important in procuring wind and solar PV given their rapidly declining costs.

Overall, feed-in tariffs have been less successful than auctions in attracting private investment in power generation. Uganda implemented a ‘global energy transfer feed-in tariff’ (GETFiT) in 2013 and this programme has now expanded into Zambia. The programme allows international institutions to supplement the electricity prices offered to small-scale IPPs (1-20 MW) using solar, hydro, biomass and bagasse. However, in both Uganda and Zambia, GETFiT is beginning to use competitive auctions for solar PV, given the rapidly declining costs of the technology.

Feed-in tariffs may prove effective for procuring small installations or fostering new renewable energy industries in countries where the cost of doing business is not yet understood by IPPs. However, competitive auctions have tended to deliver more private investment in power generation at a lower cost.[17]

Competitive auctions are also easier to integrate with power sector planning processes than feed-in tariffs, because they allow a government to procure a certain volume of power, rather than set an administratively determined tariff and hope for the right quantity of investment.

A key criticism of competitive auctions is that they can be expensive to run as they require substantial planning and highly skilled and experienced personnel. But the experience of countries like Zambia and South Africa suggests that these costs can be more than offset by the lower costs of power.[18]

South Africa's Renewable Energy Independent Power Producer Procurement (REIPPP, Box 1) demonstrates that held regularly, through transparent and predictable planning processes, competitive tenders can catalyse innovation in renewable energy industries and simulate a pipeline of bankable projects.[19]

Box 1. South Africa's Renewable Energy Independent Power Producer Procurement

South Africa has one of the fastest growth rates in renewable energy investment globally. Wind and solar power tariffs in South Africa are amongst the cheapest in the world, and cheaper than some domestic coal power.[20] This success was driven largely by REIPPP, a competitive tender process that aims to facilitate private investment in grid-connected renewable power generation. Between 2011 and 2015, IPPs were invited to submit project proposals for renewable generation through four competitive bidding windows. The results have been staggering:

- **92 contracts** have been awarded, from over 300 submitted bids, for large-scale renewable power plants (greater than 5 MW)
- **More IPPs** were contracted in four years than the cumulative total of the rest of the continent
- **6327 MW in renewable capacity** has been contracted, mostly from wind and solar PV
- **US$20.5 billion in private investment** has been attracted
- **Solar PV and wind tariffs plummeted** by 71% and 48%, respectively, from 2011-2015, and are now below the state-utility Eskom's average cost of supply
- **51 projects were fully operational** as of September 2016, illustrating both the shorter construction time required for renewable versus thermal generation, and competitive auctions' ability to deliver operational plants in a timely manner.[21]

None of the contracts have been challenged, and none of the projects have failed. According to Professor Anton Eberhard, 'No other government-initiated programme in South Africa rivals the scale of investment achieved, or the degree of transparency.'[22]

3.6. Finance & risk mitigation

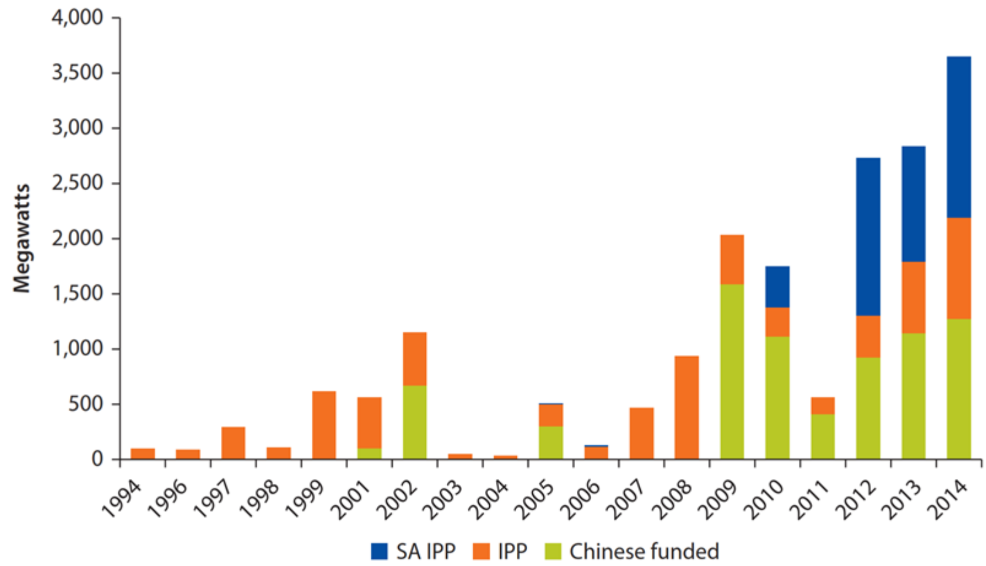
Governments and state-owned utilities have historically provided the bulk of financing for new power generation in Sub-Saharan Africa. Yet political challenges and poor credit ratings prevent governments from raising or borrowing sufficient revenue for power sector investments. Ultimately, both public and private finance will be needed to close the investment gap.

The two fastest growing sources of investment in power generation in the region are Chinese-funded projects and IPPs (Figure 4):

- **Chinese-funded projects**: From 1990-2004, 34 Chinese-funded projects were implemented in 19 countries, totalling 7.5 GW. The majority were large hydropower plants. These relied heavily on Chinese contractors and soft loans and export credits provided by the Chinese ExIm Bank.[23]

- **IPPs**: Around 124 IPPs now operate in Sub-Saharan Africa, representing $25.6 billion in added investment and 11 GW of installed capacity. IPPs still only contribute around 6% of the region's total grid capacity, but have increased rapidly in recent years. While the majority of historical IPP investment was in thermal power, most new investment is in renewable generation. Renewable IPPs are concentrated in South Africa, but are spreading throughout the region.

Figure 4. Chinese-funded power projects and IPPs, by generation capacity in Sub-Saharan Africa, 1994-2014[24]



Enabling renewable energy IPPs also frequently requires public fiscal commitments. Private investment in renewable power will not be forthcoming without the appropriate risk-adjusted returns. Governments and development finance institutions (DFIs) have a role to play in managing the incentives for IPPs and private investors. Risks in renewable energy projects include:

- **Technological risk**: Actual risks exist where new technologies have yet to be proven reliable at scale or in a specific context. 'Perceived risks' can also affect the cost of capital where investors are unwilling or unable to evaluate investments in unfamiliar technologies.[25]

- **Regulatory risks**: Changes in laws or regulations may adversely affect a project.

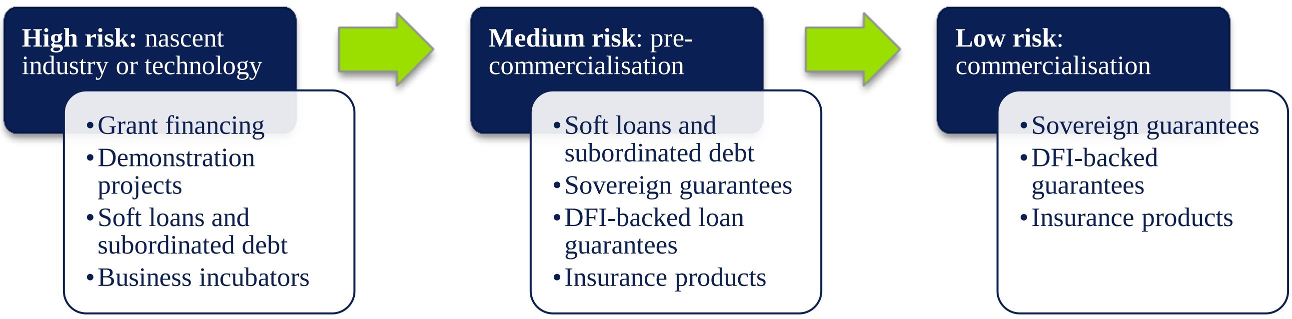
- **Political risks**: Political instability or host government actions may undermine a project.
- **Payment risks:** The offtaker (i.e. utility) may default on payment contracts or pay late.
- **Currency exchange and convertibility risks:** Shifts in currency values or difficulties in converting between currencies could adversely affect a project where financing is foreign-currency denominated and project revenue is in the local currency.[26]
- **Risks around land procurement and transmission infrastructure:** A project may be cancelled or delayed if an IPP is not able to acquire the land on which a power plant is based or if the transmission lines required to exit the power are not constructed in time.[27]

Governments can absorb some of these risks themselves to improve private investors' risk-adjusted returns. PPAs can be structured so that governments or state-owned utilities, rather than the IPP, bear the risks involved in land procurement and transmission line construction. Where the offtaker is a state-owned utility, and there are questions around its ability to make timely payments to the IPP, governments can reduce risks to investors through sovereign guarantees, certifying that they will cover any of the utility's unmet payment obligations.

Development Finance Institutions (DFIs) can also help crowd-in private investment. They can provide capital directly to a project, for example, through grants and financing mechanisms that blend public and private capital. DFIs can also buy down the cost of capital by using investment guarantees or insurance products to absorb a portion of the risk. Risk guarantee facilities – including those operated by the World Bank, African Development Bank and Private Infrastructure Development Group[28] – have proven particularly effective in reducing investors' risks associated with currency exchange rates and unstable policy environments. To date, not one IPP in Sub-Saharan Africa has invoked guarantees, including cases where the project failed.[29]

To promote private investment rather than compete with it, DFIs should focus on making projects bankable by bearing risks the private sector is ill-equipped to handle. Generally speaking, more capital-intensive public financing mechanisms – grants and demonstration projects – should strategically target higher risk renewable energy technologies or countries, leaving lower risk projects to the private sector (Figure 5). Less capital intensive public financing mechanisms – loans, guarantees and insurance products – can target medium- to low-risk projects helping nascent renewable energy technologies and companies bridge the so-called "valley of death" to reach commercial viability. Kenya's geothermal industry – discussed in Box 2 – provides an example of how committed and persistent public support for cutting edge renewable energy technology can foster the entrance of private actors.

Figure 5. Targeting public support towards higher risk renewable energy projects



Box 2. Kenyan geothermal power

Kenya currently generates 250 MW of electricity from geothermal energy, roughly 14% of its total installed capacity. Another 280 MW are currently under development.[30] Olkaria III, a 52 MW power plant, was the first privately funded and developed geothermal project in Africa. Owned and operated by the company Orpower4, the project had a cost of US$445 million.

Geothermal projects only became commercially viable after decades of public support. Initially, private investment in geothermal was impeded by high upfront costs and risk associated with exploration and drilling. Technical and financial support from the public utility and several international development partners was needed to prove the viability of the resource and develop a skilled workforce and reduce risk to private investors.[31] Drilling of deep exploratory wells began in 1973 with funds from the United Nations Development Programme.

Even after the resource was proven capital constraints impeded development, until 1981, when KenGen, a state-owned power generation utility, installed the 15 MW plant Olkaria I.[32] KenGen continued to develop the resource throughout the 1990s with co-financing from the World Bank, European Investment Bank and KfW.

With increased interest from the private sector, the United Nations Environment Programme, Global Environment Facility and World Bank sought to extend the lessons from Kenya. They established the US$18 million **African Rift Geothermal Facility** will build a regional network of geothermal experts and promote regulatory frameworks supportive of geothermal development.[33]

4 Conclusion

Some Sub-Saharan African nations have seen record levels of private investment in renewable power generation in recent years. Other nations, in contrast, have struggled to attract any investment at all. The challenge to renewable power deployment in these countries is no longer the higher costs of renewable technologies. Nor is it a lack of renewable resources, of which Sub-Saharan Africa is richly endowed. **The challenge, rather, is in fostering an enabling environment for renewable energy investment**.

There is broad understanding of factors that enable private investment in renewable generation: power sector planning, grid design and interconnection, a regulatory framework for IPPs, independent regulation, competitive procurement and finance and risk mitigation. South Africa's impressive success in scaling up private investment in renewable power, along with Kenya's success in fostering a thriving geothermal industry, provide particularly valuable lessons in enabling private investment in renewable generation.

The EEG research programme can play an important role in **distilling lessons from these and other success stories, and helping to apply this 'best practice'** to other Sub-Saharan African nations aiming to close the renewable energy investment gap.

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