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# Africa and Renewables

Wholesale change or  
short term surge?

June 2018

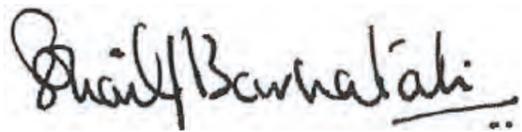


## Foreword

The scale of need and opportunity for power and infrastructure project development in Africa remains colossal. In the 49 countries of sub-Saharan Africa, only approximately one-third of people have access to electricity. The estimated investment need for Africa is USD 50 billion per annum with two-thirds of that needed for power and transportation infrastructure.

This report explores how utility-scale renewable energy projects are being deployed across sub-Saharan Africa. It covers the decisions that have been taken and their successes and failures; the persisting hurdles and new opportunities; and how experiences in individual countries are informing deployment decisions in others.

At Hogan Lovells, we aspire to work on Global Game-Changing projects around the world that transform regional trade, hike national GDP, create transformational technology, commercialise new financing techniques, mobilise new liquidity pools, impact government/global policy, improve regulatory environments and ultimately improve people's lives.



Sohail Barkatali  
Partner, Dubai



Alex Harrison  
Partner, London



Policymakers across Africa face the difficult task of weighing up a multitude of options to spur the deployment of power from renewable energy sources to supplement their existing generation mix. Much is at stake; creating the right frameworks and clear policies has a huge impact on renewable energy deployment and usage rates.

**Structural considerations**

One of the first key decisions, from a procurement perspective, is choosing whether to procure renewable power through a feed-in tariff (FiT) regime, through competitive auctions, or through directly negotiated transactions that continue to feature in some jurisdictions. Experiences elsewhere in the world show that FiT regimes, while opening the door for renewable energy projects, may risk burdening utilities and offtakers with expensive power if tariffs are set too high. In addition, record-breaking low prices seen in the Middle East and elsewhere – for example, in relation to solar power – strengthens the argument that competitive auctions may be preferable and many African countries are shifting their approaches accordingly.

As a consequence of the use of utility-scale energy projects, offtakers are often required to accept intermittent energy into their grids – this may require grid enhancements, the funding for which remains an issue that may affect the growth of renewables in Africa. Connectivity to demand centers is also important. In cases where the relevant resources are far from demand centers decision makers need to consider interconnection constraints in transporting the energy to end users.

Other considerations include:

- Development of local industries
- Transfer of technology
- Training
- Use of local content
- Employment of nationals

- Stimulating growth of local capital markets (through share retention in the project)
- Availability of foreign currency
- Managing any exchange control restrictions
- Addressing credit support issues
- Trying to overcome the challenges facing rural electrification.

Another key decision is whether to stay on-grid or move off. Off-grid solutions have gained popularity in some countries (for example Tanzania and Ghana), while others (such as Gabon) are choosing to focus on extending their grids to new customers.

**An evolving landscape**

Developers are coming up with increasingly creative project proposals. For example, an ambitious project incorporating solar power, biomass, hydropower,

and heat into an industrial complex in Africa was recently proposed for development agency funding but not developed. Proposed structures for financing projects are more diverse, reflecting new models and instruments in the market such as crowdfunding and micro-lending.

Technological advances have facilitated even more paths for development and will continue to do so. Procurers can be overwhelmed by the wide range of options they face – for example, not only in relation to the type of technology but also in relation to maturity of the technology – and this has the potential to lead to project structuring issues, and delay overall procurement and funding timelines.

**A bright future?**

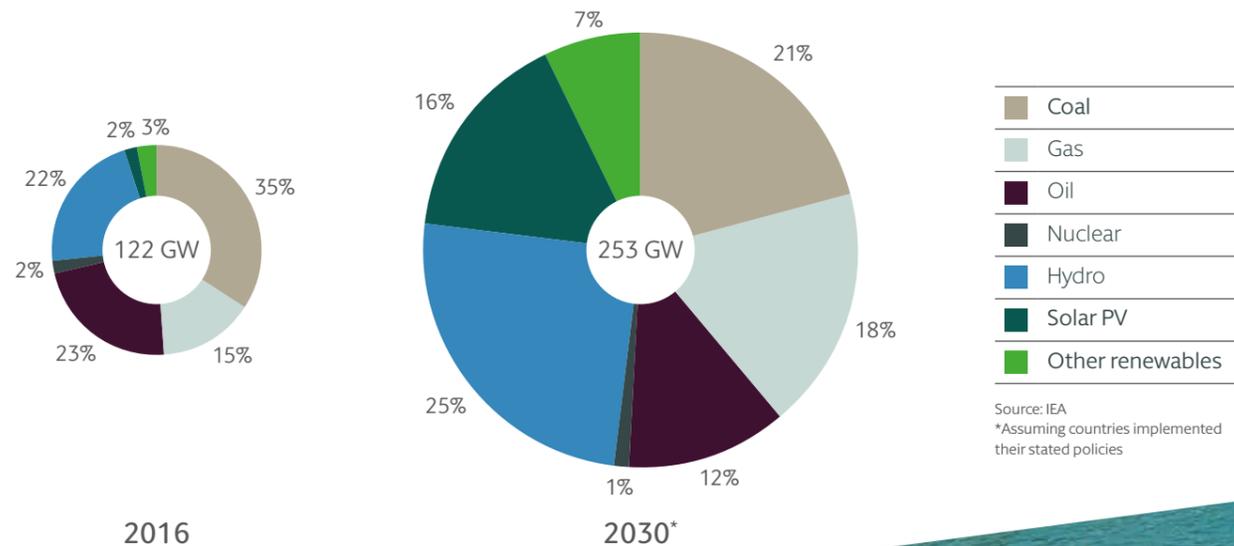
Africa has enviable solar irradiation levels almost everywhere across the continent, along with excellent wind, hydropower, and biomass resources, while geothermal potential is distributed less evenly. African countries have high solar potential, of around 10,000 GW, with the potential for solar PV alone estimated at 6,500 TWh per year. Coastal countries have high wind potential amounting to around 109 GW. The Great Rift Valley in East Africa offers around 15 GW of geothermal capacity, mainly in Kenya and Ethiopia. As the continent is home to the powerful Nile and Congo rivers, hydropower potential is also apparent with an estimated capacity of 350 GW.

With so much interest from developers willing to invest equity and capital from private sources and Development Finance Institutions (DFIs) available, a lack of capital or renewable resource is rarely the main barrier to entry. While some of the challenges facing renewable energy deployment are country-specific, the experiences of one country do inform decisions and outcomes in others.

“Renewable energies have increasingly become a sustainable and competitive choice for improving African countries’ security of supply and independence from fossil fuel imports. With the appropriate institutional and regulatory support and proper tendering practices, renewable energy projects can also achieve the best possible outcomes in terms of tariff levels and overall project quality, for the benefit of the local consumer. However, even in countries that have the political will and prior experience with Project Finance and PPPs, and that have set up adequate legal & regulatory frameworks, the negotiation of bankable legal documents (starting with Power Purchase Agreements) can be a lengthy and complex process. Many challenges point to the necessity of ensuring continued assistance to governments in the area of PPP project preparation, tendering and implementation.” says Svetla Stoeva from the European Investment Bank.

Installed power generation capacity in sub-Saharan Africa by fuel in the New Policies Scenario

Power generation is predicted to more than double by 2030, and hydropower overtakes coal to become the largest share of installed capacity.



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We see too many projects in the market with PPAs [power-purchasing agreements] running at US\$0.20 [per kWh] for solar PV.

Romain Py, AIIM

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# Procurement strategies

One of the most common challenges to renewables deployment across Africa is centered around procurement strategies. “The main challenges we are facing pretty much across the board [are] to do with lack of clarity on proper procurement processes,” said Yasser Charafi, a principal investment officer for Africa at the International Finance Corporation (IFC). “Developers are going into countries on account of there being a renewable endowment but finding there is no clear framework for deciding on projects.”

### Moving goalposts

This is immensely frustrating for developers. “Many developers find themselves spending a lot of time, energy and money developing sites that are essentially remaining in the air because of uncertainty on whether they would be awarded a project or [if their proposals would even be] considered. This is the main challenge. The countries that have [succeeded] or may [succeed have used a] clear procurement process,” said Charafi. Equally, and frustratingly, political interference, administrative delays and bureaucratic intransigence can also upset even the best of programs. An example of this is the recent refusal of Eskom to sign 27 power purchase agreements (PPAs) under the South African Renewable Energy Independent Power Producer Procurement (REIPPP) program, coupled with cabinet reshuffles that resulted in the energy minister being replaced three times in a short period.

### FiT for purpose?

Many countries initially offered FiTs but have since switched, or plan to switch, to capacity procured through auctions. For example, Mauritius offered small-scale producers US\$1.00/kWh of electricity produced but recently switched to tendering larger projects, so it could access cheaper tariffs and finance through DFIs. Countries that want to stick with FiTs but are not able to offer sufficiently attractive tariffs can apply for DFI assistance. The World Bank’s Global Energy Transfer Feed-in Tariffs (GET FiT) Program, which provides developers with a top-up tariff, is one such example that can be applied across many countries.

In Uganda, where the first phase of the initiative was launched, GET FiT offers developers a top-up payment of US\$0.014/kWh for hydropower and US\$0.010/kWh for biomass. Funding contributions came from Norway, Germany, the UK and the European Union. The program has helped fast track 17 small-scale renewable energy projects in the country, with a total installed capacity of around 160 MW.

The FiT provided by Uganda's regulator, the Electricity Regulatory Authority, is payable against actual delivery of energy, while 50 percent of the GET FiT premium is payable on the commercial operation date with another 50 percent disbursed through the first five years of operation. GET FiT also provides additional support, for example, in standardizing legal documents and offering other risk-mitigating measures to enable developers to easily finance their deal. GET FiT Zambia was also launched earlier this year.

### Auctions causing waves...

Headline-grabbing tariffs from renewables auctions, most notably in Senegal – €0.0380/kWh at Kahone and €0.0389/kWh at Touba (approximately US\$0.05/kWh) – and South Africa, have spurred the shift towards open auctions. In South Africa's case the shift to auctions was driven in part by the Public Finance Management Act, which requires procurement to be by way of an open bidding process. DFIs tend to prefer competitively tendered projects as they can be a more efficient route to optimal pricing at the time of the tender.

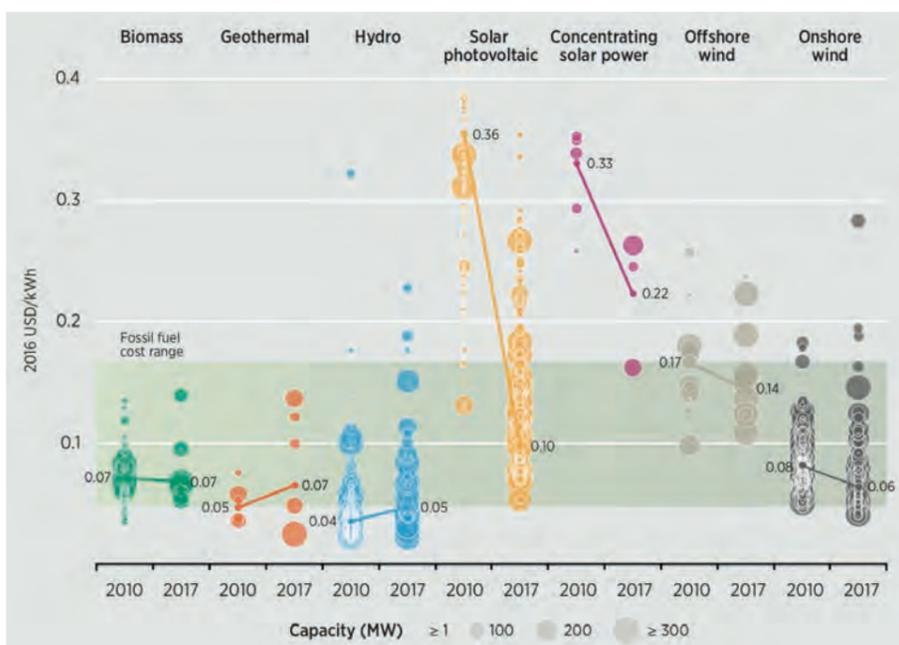
"If you asked me what the price of solar PV should be in Botswana I wouldn't know. It depends on many different factors," said Charafi. "We think that in this first stage competitive tendering and auctions [are] the right way to get a better sense of [...] the right cost of electricity."

Big developers are largely in favor of auctions too. "Transparent and competitive bidding is the only way forward," said Paddy Padmanathan, chief executive for ACWA Power International. "Negotiated transactions and projects relying on feed-in-tariffs are the ones that can – and do – get abused. They end up keeping prices artificially high and end up costing the public a lot of money. It's been proven time and again."

Pitching and updating FiTs so developers receive the right incentives is tricky, particularly in light of the huge drop in the price of renewable power. Global solar PV prices fell from US\$0.36/kWh for utility-scale projects in 2010 to US\$0.10/kWh in 2017, according to IRENA data.

Solar PV has gained the most traction in Africa because of the scalability of projects and the quality of solar resources found across almost the whole continent. This has been supported by a number of solar specific initiatives such as the World Bank's Scaling Solar programme and the African Development Bank's Desert to Power initiative, which is aiming to develop 10 GW of solar energy across the Sahel region immediately south of the Sahara desert in collaboration with the Green Climate Fund and the Africa50 investment fund. As more countries look to address rural electrification through the deployment of mini-grid solutions the trend is likely to continue.

### Global levelised cost of electricity from utility-scale renewable power generation technologies, 2010-2017



Source: IRENA Renewable Cost Database.

Note: The diameter of the circle represents the size of the project, with its centre the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE value for plants commissioned in each year. Real weighted average cost of capital is 7.5% for OECD countries and China and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.

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Solar tenders in Africa have the potential to be genuine game changers.

*Yusuf Macun, Cranmore Partners*

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### The drive for value

The rapid decline in the cost of renewables also affects projects procured through auctions, as governments can choose to delay their rounds to secure better prices. Some authorities are facing fresh scrutiny over contracts they awarded that offered too much upside to developers. This is leading to efforts to re-open tariffs in some jurisdictions.

“We see too many projects in the market with PPAs [power-purchasing agreements] running at US\$0.20 [per kWh] for solar PV,” said Romain Py, head of transactions at Africa-focused infrastructure investment managers AIIM. “Even at US\$0.12/kWh in a place like Kenya, it doesn’t make sense to me when we see tariffs below US\$0.10/kWh [elsewhere in] the continent.” Pressure on tariffs is a sentiment echoed by others. “Recently we have seen more and more pressure on tariffs. We can take for example Egypt (tariff renegotiated from USDc 14 to USDc 8.4/kwh), Zambia (USDc6-8/kwh) and more recently Senegal (below USDc 4/kwh). At first sight, this should have a positive impact on the sector finances and/or end user tariffs. At the same time many developers are either discouraged, potentially leading to less power projects, or the pressure is translated in very aggressive concessionary finance terms, which do not reflect the market situation.

In the long run, there is a risk that this will ultimately lead to less IPP-type investments in the energy sector.” says Roxana Ignat at FMO, the Dutch Development Bank.

Declining tariffs is becoming a reality across the continent. For example in Kenya, there have been recent further reductions in tariffs; with Kenegy Renewables rumored to have signed a 20-year PPP with Kenya Power for its 40MW solar plant (the Rumuruti project in Laikipia County) with an agreed price of just US\$0.08 per kWh.

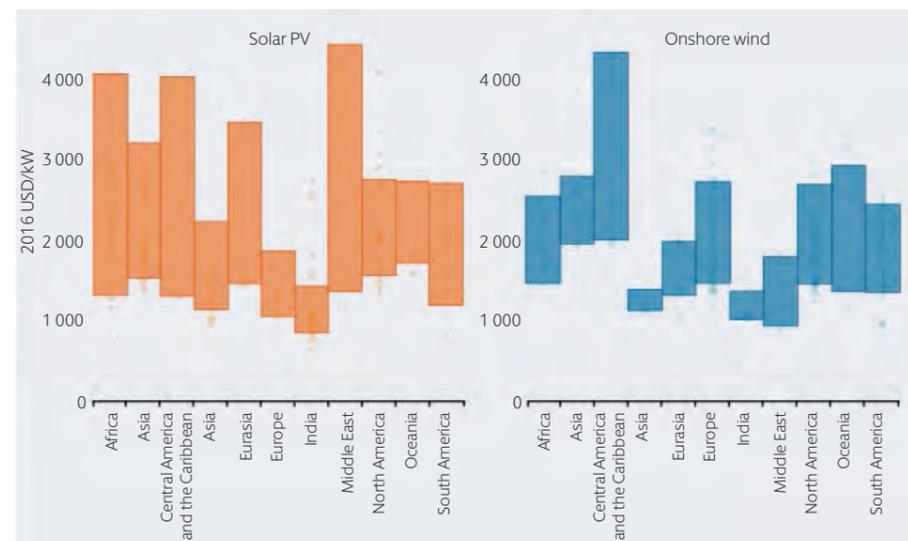
Pricing for CSP and wind projects has been more consistent as their costs have fallen by much less than solar PV. Concentrated solar power (CSP) costs fell by 25 percent between 2010 and 2017, according to IRENA data. Onshore and offshore wind prices have fallen by 25 percent and 17.6 percent respectively over the same period.

Wind and CSP projects have been developed where natural resources are strong and government support is high. However, many more wind projects could have been developed in parts of Africa where the initial costs of projects could be covered by governments and DFIs. This being said, projects may be hindered because setting up a wind mast to measure speeds is costly and time-consuming.

### A long term view

If a deal is considered disadvantageous to the country’s citizens in retrospect, developers risk being forced to renegotiate later in the life of the project. “It is the older, more expensive deals that governments are seeking to renegotiate,” said Chris Cross, a Dubai-based partner at Hogan Lovells.

Regional total installed cost ranges for onshore wind and solar PV, 2016/2017



Source: IRENA Renewable Cost Database.

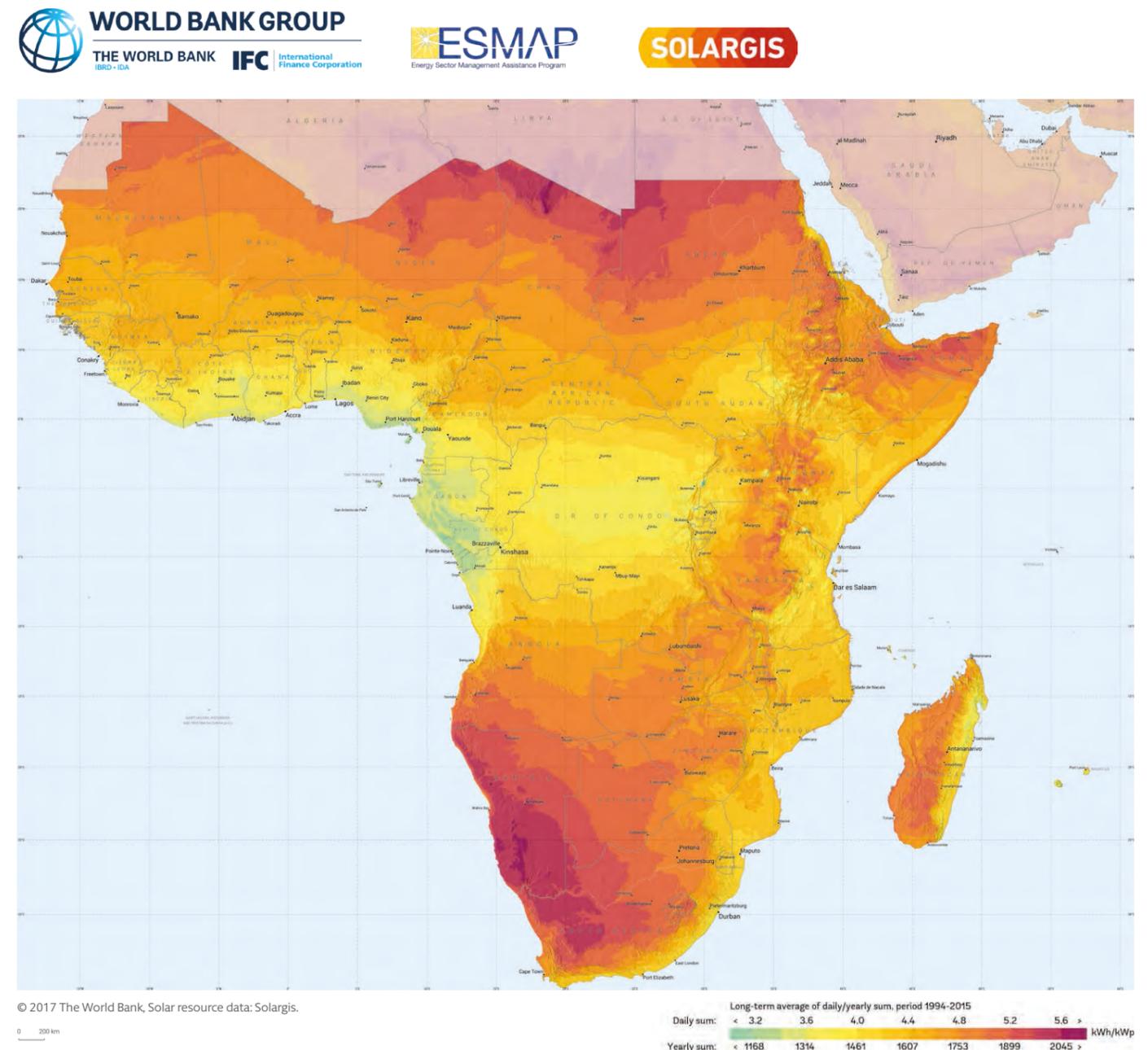
“Solar tenders in Africa have the potential to be genuine game changers, shortening the development cycle to financial close, providing very attractive economics for the offtakers, and

arguably decreasing political risk for debt and equity on the transactions. Wind, given the resource volatility and technical complexity, will most likely remain more marginal. And hydro, where available, will need

to justify its economics to continue to be relevant,” said Yusuf Macun, managing partner at Cranmore Partners in Dubai.

### Solar resource map

Photovoltaic power potential - Sub-Saharan Africa



Paddy Padmanathan, ACWA Power International discussing South Africa's REIPPPP:

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The quality of the procurement documents, and the rules and regulations; how they set them up, and how they monitored and managed them; and the balanced risk transfer to the private sector were key to the program's success.

*Paddy Padmanathan, ACWA Power International*

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## Case study

### South Africa and renewable deployment

South Africa's Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has demonstrated the potential of auctions for renewables capacity, and the benefits of a clear procurement regime.

The country has developed a successful regime for renewables deployment through a series of rounds and pricing that has adjusted as the market has matured. A total of 6.4 GW from 102 independent power producers (IPPs) has been procured through the program so far, and the regime now attracts a healthy level of interest.

“The REIPPPP has been a success because the rules of engagement have been clear,” said Charles Marais, a consultant at Hogan Lovells in Johannesburg. “Each [request for proposals] has set out expectations on price, local ownership and local content [...] An announcement on future bidding rounds is expected during the current year, and both developers and lenders are likely to show similar levels of enthusiasm as they have in the past.”

The IPP office is often described as an ‘island of excellence’ within the South African government. The success of the small team has raised hopes that if other countries also pull together a unit of dedicated, competent officials, and follow a similar clear and well-defined tender process, South Africa's success could be replicated elsewhere in the region.

“The quality of the procurement documents, and the rules and regulations; how they set them up, and how they monitored and managed them; and the balanced risk transfer to the private sector were key to the program's success,” said Padmanathan.

“The whole process was very well thought through. The IPP office did a fantastic job of thinking through all the ways in which the private sector could potentially abuse the system – and then they blocked all those options,” said Padmanathan.

For example, developers could not submit bids unless their projects had already secured land, environmental clearances, and the necessary grid interconnections – rather than assuming these permits could be secured after selection.

# Case study

## How Scaling Solar aims to create viable markets for solar power

Scaling Solar offers a template to assist governments in addressing obstacles to the development of utility-scale solar power.

Scaling Solar is a 'one-stop-shop' initiative designed by the World Bank to create viable markets for solar power in emerging markets through standardization. It aims to address the frequently voiced complaint from developers and financiers that a lot of time and money can be wasted researching opportunities in many countries with different incentive and legislative regimes.

With Scaling Solar, the IFC takes the early-stage development risk for the projects by identifying the right site and grid connection points, and negotiating project contracts. Projects are also guaranteed a high level of support and involvement from government authorities.

"[Scaling Solar is] establishing a template for solar deployment and reducing tendering timescales and costs, but putting these structures in place and building market understanding of them and the related bankability issues takes time, and can require market-specific adaptation," said Alex Harrison, a London based partner at Hogan Lovells.

Senegal set a new benchmark for solar power pricing in April through its first tender under the initiative. The winning bidder has been awarded contracts to supply power for less than US\$0.05/kWh from two projects with a combined capacity of 60 MW.

The tariff undercuts the price of US\$0.06/kWh that Zambia secured under its first phase of Scaling Solar.

"The main contributors to reducing our tariff was, at that time, the perspective of a very fast development-to-financial-close process, as well as the support of the World Bank with a partial risk guarantee, reducing the offtaker risk," said Cyril Perrin, regional director for southern Africa at Neoen Solar. Ethiopia and Madagascar have also tendered under the initiative.

While Scaling Solar and the IFC's templated approach can greatly speed up the development of projects, their progress "is not always quick", said Josefin Berg, research and analysis manager, solar and energy storage at IHS Markit. Some aspects that hamper IPP development in emerging markets still apply, such as land rights, unclear regulatory regimes and administrative hurdles.

There are other inter-governmental efforts to standardize incentives for renewables across countries. The Economic Community of West African States' Centre for Renewable Energy and Energy Efficiency has also looked at standardizing incentives across West Africa.

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*Cyril Perrin, Neoen Solar*

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## Case study

# Lake Turkana wind farm

Lake Turkana wind farm, in northwest Kenya, started commercial operations in 2017. It is Africa's largest wind farm, with a capacity of 310 MW, comprising 365 wind turbines of 850 kW each. The sponsors, a group of Dutch entrepreneurs and UK-based Aldwych International, have a contract to operate the project for 20 years.

The project lies between two mountains that produce a tunnel effect that increases wind speeds. The load factor is around 62 percent as a result, according to the project company.

At a cost of more than €620 million, Lake Turkana wind project is the largest single private investment in Kenya's history. However, most of the investment was made by DFIs, including the African Development Bank (AfDB), European Investment Bank (EIB), Dutch development bank FMO and Proparco.

While the project is considered to be a success, it faced many challenges in its development. Its biggest hurdle took the form of land disputes. Residents sued the county government in 2014, claiming they were not consulted before the land was leased. The company said it had held several public meetings when the local government issued the lease. The court sided with the developers, allowing work to begin.

The developers of a proposed 61 MW wind farm at Kinangop, about 160 km north of Nairobi, are dealing with disputes over the project land. Plans collapsed in 2015 after some residents demanded more money, while other residents claimed the project would be a health hazard.

As the first IPP in Ethiopia, [Reykjavik Geothermal] has helped create the legal, financial and technical framework for the historic project.

*Emmanuel Birba, Meridiam*

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## Case study Geothermal in Ethiopia

Ethiopia is looking to replicate and better Kenya's success in geothermal power development in the hope of meeting its growing domestic demand for power and possibly even export electricity.

The government issued its first geothermal exploration license in 2009 and suitable sites for development have since been revealed. Ethiopia signed 25-year PPAs for two geothermal power plants in December 2017. The Corbetti and Tulu Moyo plants, which will be built in the Rift Valley south of Addis Ababa, will have a combined capacity of 1.4 GW.

Reykjavik Geothermal, an Icelandic company backed by billionaire hedge fund manager Paul Tudor Jones and Ambata Capital Partners, is involved in both projects. They are expected to cost about US\$2 billion each.

Meridiam and Reykjavik Geothermal are developing the Tulu Moyo project alongside investors from France, United States and Iceland. The first 50 MW of the project is scheduled to start up in 2020, with full completion scheduled for 2023, according to Reykjavik Geothermal.

Reykjavik Geothermal, Iceland Drilling, African Renewable Energy Fund and InfraCo Africa are equity investors in the Corbetti plant. The project has

received support from Power Africa, AfDB and the UK government.

The developers are now seeking around US\$1 billion in debt finance for the two projects from development banks, in addition to US\$500 million from export credit agencies. The Olkaria III geothermal project in Kenya, which was developed by Ormat in several stages, was supported by the EIB and the World Bank Group's Multilateral Investment Guarantee Agency. The developers took steam risk although that is now changing. With plans underway to issue an RFP for Olkaria VI, steam-field risk is no longer taken by the developers but has become the responsibility of the offtaker and government-owned Geothermal Development company.

Ethiopia's lack of previous geothermal power development meant the developers of the Corbetti and Tulu Moyo projects were able to guide the development of the laws and regulations they would later abide by. "As the first IPP in Ethiopia, [Reykjavik Geothermal] has helped create the legal, financial and technical framework for the historic projects," said Emmanuel Birba, a project manager at Meridiam, following the signing of the project documents in December 2017.



## Creative financing

It is rare for projects to fail because of a lack of financing. “This is not a financing problem and it won’t be solved by throwing more money at it. There’s already too much money going around,” said Charafi.

Even so, financiers and governments are increasingly looking at innovative financing solutions to get projects off the ground. In South Africa, for example, commercial banks faced with concentration risk removed assets from their balance sheets through securitization processes, thereby liberating capital for the next opportunities. In Nigeria, a US\$30 million sovereign green bond was issued in December 2017, making Nigeria the first African country and only the fourth in the world to do so.

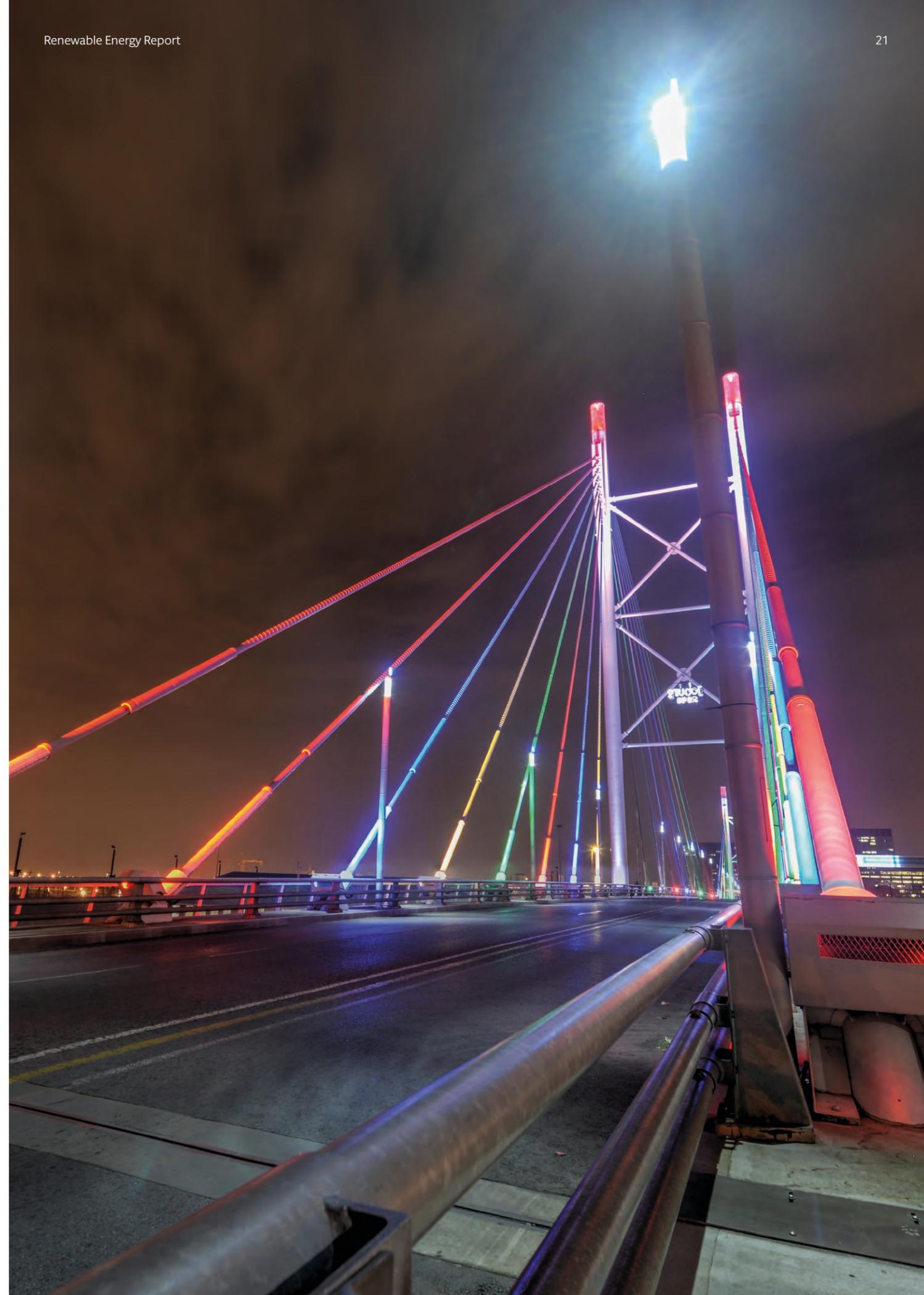
“It takes significant efforts for a country to issue its first green bonds compared to traditional bonds,” said a World Bank spokesperson who worked on the deal. Nigeria had to build capacity within its ministries and authorities, schedule its bond to coincide with the national budget, coordinate its institutions and build criteria for projects to receive the funds, the spokesperson added. With more African governments using sovereign bonds to raise debt for infrastructure projects generally, more green bonds are likely to follow.

Private equity is also featuring more heavily in the financing of renewables projects in Africa. At least US\$4 billion from private equity and hedge funds will be used to finance Ethiopia’s upcoming geothermal projects as it attempts to replicate the success Kenya has

had in becoming the world’s eighth-largest geothermal power producer. East Africa’s geothermal potential exceeds 15 GW and represents a US\$40 billion investment opportunity, according to USAID-led initiative Power Africa.

Chinese participation in the financing of renewables projects has been high, particularly in large-scale hydropower projects, and this trend is set to continue. The Kaleta and Souapiti dams under construction in Guinea – which will have a combined capacity of 800 MW – were financed by Chinese investors and have engineering, procurement and construction contractors from China. Another Chinese-backed hydropower project is under construction in Uganda.

Given the level of interest shown by developers from the Middle East in African renewable energy projects, Islamic financing could offer an additional source of funding. Islamic lenders will consider the bankability of any project on its merits. However, the development banks within the Islamic space that seek out opportunities are not solely driven by commercial gain. “Renewable energy projects in Africa lend themselves to the ethos of Islamic finance, which fundamentally seeks to better peoples’ lives in addition to generating a return for investors,” said Imran Mufti, a Dubai-based partner at Hogan Lovells.



# Overcoming physical challenges

The development of clear fiscal policies designed to support the renewables sector remains an important aspect for ensuring continued participation. Governments have had to consider providing projects with tax breaks and exemptions. These measures vary from waiving import duties on capital equipment during construction to tax holidays – in relation to income tax. Tax incentives may also be available to support the creation of local industries around the renewables sector. This can apply to roof-top solar solutions where, for example, companies have gone off or minimized their reliance on the grid by switching to renewable energy.

## Infrastructure

Importing the specialist infrastructure needed to construct renewables projects is a frequently cited concern for developers. Several governments are working to alleviate the burden through tax exemptions for renewable energy. The Democratic Republic of the Congo, which has a technically feasible hydropower potential of around 100 GW, is waiving duties on hydropower equipment to attract investment to the sector.

## Overcoming delays

Without these exemptions and the cooperation of local tax authorities to ensure they are appropriately applied, “projects are at a very large tax risk and under additional time pressure due to delays in the import of materials and associated additional costs”, said Stefan Erath, a sales manager for large hydro at Andritz Hydro – which has installed around 1 GW of hydro capacity in the country.

In Mozambique, the government is considering establishing a specific tariff regime for importing solar goods and removing VAT on solar equipment. Currently import costs on solar goods are estimated to be as high as 30-40 percent, making Mozambique uncompetitive with countries such as Ethiopia, Ghana, Tanzania, Uganda, and Zimbabwe, where successful exemption regimes have been applied.

## Distribution

Much of Africa’s best wind resources are located in the east, but the development of new capacity is stymied by a lack of demand. Until the grid transmission and distribution infrastructure is extended to more customers, or more micro grids are built, it is difficult to justify investment in new renewables capacity. This highlights the fact that the optimum resource may be located away from the demand centers. For example, the Lake Turkana Wind Project in Kenya includes a 400 km transmission line from the plant to the Susua sub-station near Nairobi.

The fluctuating supply profile of wind and solar means they have limited potential in countries with unstable grids. For instance, Zimbabwe has vast untapped hydro, solar, and biomass resources but its grid struggles to absorb the small amount of renewable energy it currently produces. “Investment in the grid [and in grid stabilization products and services] is needed for the country to be able to use more renewable power,” said Lungile Mashele, an energy specialist at the Development Bank of Southern Africa.

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*Stefan Erath, Andritz Hydro*

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# Off-grid and mini-grid solutions

“Renewable energy sources are also essential to improving access to energy in Africa, especially in more remote non-interconnected areas, since they can be deployed as off-grid solutions both in the form of solar-based mini-grids serving communities, and solar home systems.” says EIB’s Svetla Stoeva.

Not enough attention is being given to co-ordination and integration of off-grid, mini-grid and utility-scale power systems. The main challenge for system operators is the flexibility needed to cope with intermittency and variability of solar and wind. High penetration of energy from renewable sources requires a grid enabled with ICTs and other smart grid technologies that allow real-time system monitoring and remote control of voltage, and power flow conditions critical to the rapid response needed for the variability typically associated with wind and solar. Most system operators plan their outputs around demand forecasts on a day-ahead basis that continue to be adjusted and updated in the hours and minutes ahead of dispatch. However, it is difficult to plan supply to match demand forecasts using solar and wind, as their output can vary significantly over short timescales – the wind might drop or the sun may be hidden by cloud cover.

Some countries are choosing to prioritize off-grid renewables and mini-grid solutions rather than investing in connecting remote areas to their national grids. Tanzania has been particularly successful in this regard. It typically costs Tanzania’s national utility

around US\$2,300 to extend the main high-voltage grid to a rural off-grid household, but cheaper solar power and batteries mean these homes could be connected to a mini-grid for US\$500-1,000. A quarter of all households that have access to electricity obtain it from off-grid solar PV, according to Tanzania’s Ministry of Energy and Minerals.

Off-grid solutions are technically suitable in many more areas than they are currently used. “A big portion of Africa has a population density that is too low to be grid-connected,” said AIIM’s Py. “We are seeing some very good [off- and mini-grid] business models, which are going to be rolled out and that’s going to start making a big impact.”

Ghana is looking to provide electricity to remote island communities near Lake Volta in the east of the country via mini-grids supplied by hydropower. “We have developed five hybrid mini-grids for over 1,000 inhabitants and we are also installing three mini-grids. For these mini-grids we have a target to install 55 and then scale up to all of the other island communities,” said Robert Sogbadji, the Ministry of Energy’s deputy director for clean energy.

The Scaling Off-Grid Energy Grand Challenge for Development – established in 2016 by USAID, other development agencies and the Shell Foundation – aims to accelerate growth in the off-grid energy market in sub-Saharan Africa.

## Supply vs. Demand

Developing a successful mini-grid hinges on designing the right-sized catchment area for the network. If the capacity of the network is too high compared with demand, the price of the renewable power supplied to the mini grid will seem expensive. Supporting demand through publicly funded campaigns and subsidizing lower-tier consumers through mechanisms such as voucher systems, can help drive sufficient market volumes needed for scale.

Even without specific campaigns in place to support demand in rural areas, demand for electricity typically increases naturally over time. It can therefore be difficult to predict the pace of change. A lot of off-grid companies have excessively bullish estimates for demand growth, according to Matthew Wainwright, Chief Financial Officer at Standard Microgrid.

Financing projects that yield different and uncertain returns over time can be tricky. “One of the key risks associated with financing mini-grid projects is the bankability of the offtaker market. DFIs or export credit agencies can assist in making the projects bankable by providing funding or credit support [...] during the initial ramp-up phase, with commercial banks stepping in once there is a reliable track record of demand and consumption,” said Andre Wepener, head of power and infrastructure finance at Investec.

## Taking a different path

Given the challenges of securing bank debt, South African coal miner Exxaro Resources, which is diversifying its business by investing in micro-grids, is instead financing its initial projects with full equity.

Some companies supplying solar home-system technologies are themselves acting as micro-lenders. Nairobi-based M-Kopa Solar has done this with remarkable success, connecting almost half a million homes in sub-Saharan Africa. In Kenya, clients pay a KES 2,999 (US\$29.7) deposit for the company’s basic power system – which includes a solar panel, four LED bulbs, a torch, a rechargeable radio, and adaptors for charging a phone – and then make a payment of KES 50 per day via their mobile phone over two years, utilizing the M-Pesa mobile phone-based money system.

Similar systems are being deployed elsewhere in Africa, with varying levels of success. For example, Oolu Mali is the first pay-as-you-go distributor of off-grid solar energy in Mali. Its customers benefit from flexible and affordable mobile payment plans. Customers include rural hospitals that benefit from off-grid solar energy systems. Similarly OffGridBox provides renewable energy, filtered water, and connectivity to people living off-grid in rural Rwanda. The OffGridBox is a compact unit with solar panels on the top and a water filtration system inside that is used to provide around 230 households with electricity and water daily. The adaptation of off-grid solutions to support the agricultural sector in Africa is also beginning to gain momentum.

While the technology works in Kenya, Uganda, and Tanzania, it is less successful elsewhere. Mobile phone penetration is around 87 percent in Kenya, and M-Pesa is used by at least one person in 96 percent of Kenyan households. Poorer and more remote communities, such as those found in Mozambique, have much lower mobile phone coverage and mobile money service use is still low. This type of constraint will affect the bankability of the initiative.

## Some way to go yet?

Clarity on off-grid policy remains an issue in many countries. “Regulation is the biggest problem we face in sub-Saharan Africa [...] companies and investors [developing these projects] need to be assured that [...] there is an ease of getting into the market,” said Gavin Carlson, managing director at Blue World Power and Energy Services, at the Africa Energy Indaba conference in South Africa in February 2018. “Going through a mire of regulation for small rural electrification can be a [deal] breaker.”

Permitting processes involving local authorities is a big challenge, said Wainwright. “You’ve got to get local authority permissions – that’s actually the thing that takes the longest,” he said. “You have to establish a new relationship with the community leadership, establish who the relevant authorities [are] one level up, wait for them to table the proposal and then hold a meeting to approve it.”

When local authorities do not have the capability to analyze proposals, the process can take longer still. Tanzania tried to streamline its permitting process through a one-stop-shop for developers, but it still takes a long time to receive final approvals, according to the companies that have used it.

## Regulation

Tanzania's decision to keep the market for sub-10 kW effectively unregulated has provided a boost, said Wainwright. Other countries may decide to also take a light-touch approach to regulating small-scale systems. Mozambique's requirement for all small green mini-grids to follow the same regulatory process as major energy projects undoubtedly holds back the development of off-grid systems.

"In the mini-grid space there is no simplified regulatory regime for IPPs, so whether you're setting up a 500 kW or 500 MW power plant of any variety, you have to go through the Council of Ministers to get approval for the concession. It's not justified to apply the same regulatory burden that applies to a large-scale power provider to a small mini-grid," said Emmett Costel, co-founder of Epsilon Energia Solar.

Zambia has created an off-grid taskforce – comprising various governmental arms, developers, and communities – which has been tasked with streamlining the approvals process. "In Zambia, there is a sizeable addressable market but the regulations aren't 100 percent clear. There is broad support from the government for this kind of thing but they haven't exercised what Tanzania has done with [the] overhaul of its regulations," said Wainwright.

Seeking approvals for several small projects at once can help. "Instead of assessing one site and then operating, we are doing big batches of assessments. We have gone and assessed 50 sites and found about 20 that are viable and we are busy converting and deploying them. We are able to use significant economies of scale by batch processing the different steps in the project," said Wainwright.

## The future?

Technological improvements will have a big impact on the off-grid sector. Cheaper storage will allow remote areas to better manage the peaks and troughs in their demand while receiving a typically intermittent electricity supply from renewables projects.

"Distributed generation with energy storage systems is the future of electrification in rural Africa. This is unlikely to happen on a large-scale today, but with the right policy and regulatory measures in place, there is no reason why this can't happen in the not-too-distant future," said Alex Wong, a Singapore-based partner at Hogan Lovells.



## Technological leaps

Technological advances in other areas will also have an impact on the renewables sector in Africa. “We’re seeing only the very tip of the iceberg currently in how information technology and data is going to shape the energy landscape in the future,” said IFC’s Charafi.

“It’s only now starting for monitoring consumption, optimizing consumption etc. We are seeing it cascade down into utilities – for instance, geographical information systems. We are seeing some progress in loss reduction and controlling the flows on the network with smart meters.”

Alternative funding models for projects could also emerge in the future. “You could also see situations happening with crowdfunding and mobilizing capital differently. You could crowdfund your own neighborhood power plant instead of having to rely on the utility to do it,” he said.

However, there are signs that governments may be unprepared to deal with the range of routes for development on offer, meaning new technology-enabled options may slow the introduction and implementation of other projects. “We see plenty of countries that want to do the right thing but they are unable to sift through all the various proposals that come their way,” said Charafi. “That either creates paralysis in some cases or leads to sub-optimal choices being made.”

But there are also opportunities within the right frameworks. Without pre-existing systems in place, energy stakeholders can shape the future development of the sector and it is worth disregarding pre-existing conceptions of how renewables development should evolve.

“We need to start with a clean slate in thinking about all these issues,” said Padmanathan. “The way we considered these things even three years ago is no longer relevant or applicable when it comes to electricity supply, electricity distribution, or electricity use.”

Governments across the continent need to act decisively to ensure their policies and incentive regimes are clear and attractive if they are to capitalize on the huge opportunities on offer.

“With 54 countries and in excess of 600 million people without access to electricity, falling costs of solar energy opens the door for renewables based solutions to electrify rural Africa,” said Sohail Barkatali, a Dubai-based partner at Hogan Lovells. “The challenge in Africa remains how to close transactions quickly and efficiently where power sector policy and regulation is often having to play catch-up.”

“

We need to start with a clean slate in thinking about all these issues.

*Paddy Padmanathan, ACWA  
Power International*

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