CrossBoundary Energy

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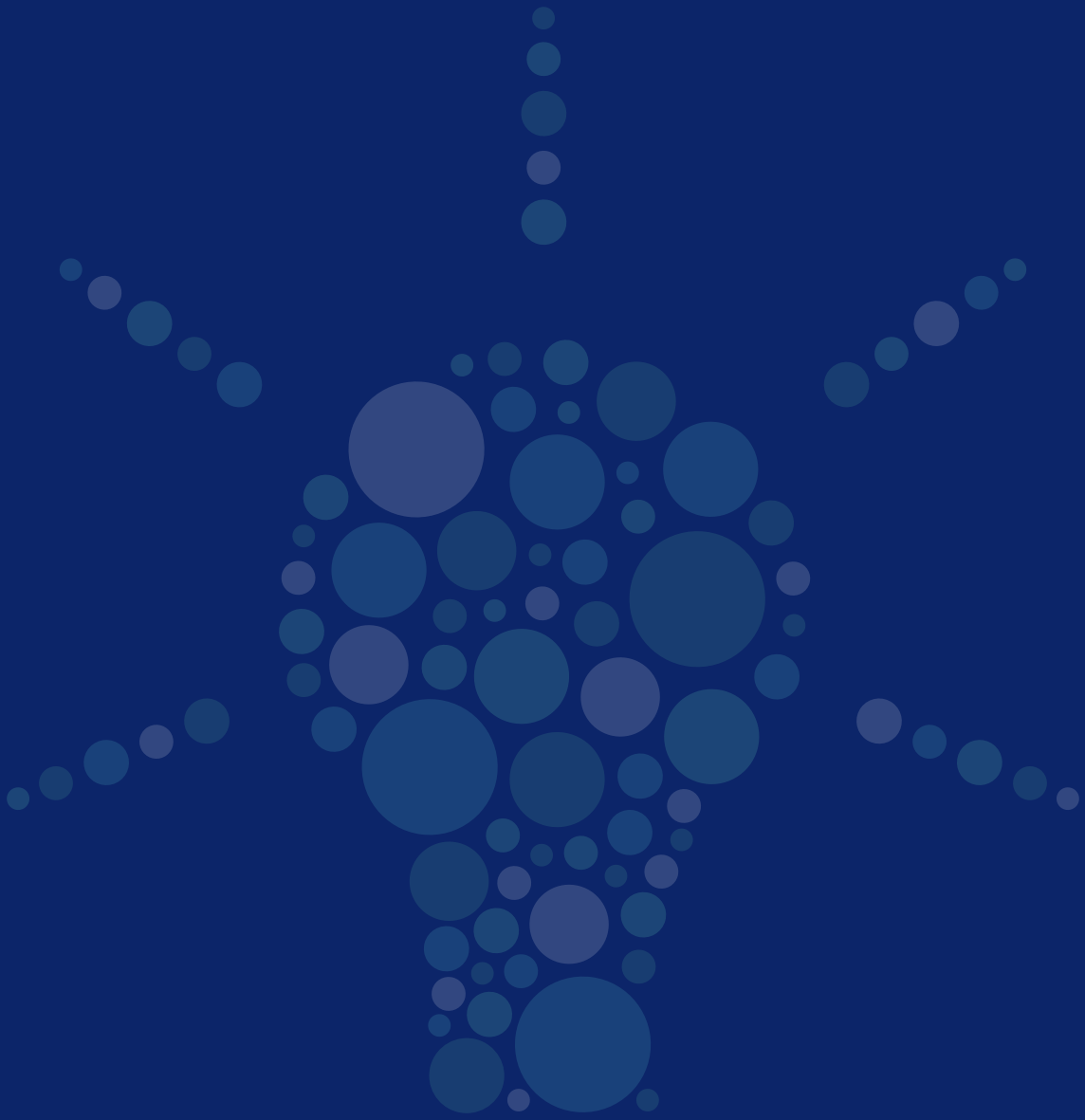
Constructing Africa's Green Economy Requires New Building Blocks



CrossBoundary Energy is a leading developer, owner, and operator of distributed renewable energy solutions for businesses, providing cheaper and cleaner energy through power purchase and lease agreements. CrossBoundary Energy is currently delivering a portfolio of over $420 million of solar renewable energy assets for clients including Unilever, Diageo, Rio Tinto, Heineken, and AB InBev, and was recognized by Africa Solar Industry Association as “Solar Company of the Year” in 2022. CrossBoundary Energy is a member company of the CrossBoundary Group, a mission-driven investment firm founded in 2011 and committed to unlocking the power of capital for sustainable growth and strong returns in underserved markets. Find out more at www.crossboundaryenergy.com.

Table of Contents

Introduction

African regulators face an exciting opportunity: the chance to leapfrog legacy energy market structures, and accelerate the integration of distributed energy resources. In doing so, they can boost grid integrity, create green jobs, and define a new and cleaner path to industrialization.

It is hard to overstate just how important this opportunity is. World Bank research continues to cite access to energy as a primary barrier to boosting firm productivity in Africa. In their latest survey of firms across the continent, nearly 80% of participating companies report experiencing power outages while 41% cited energy access as a major obstacle to business operation.

Meanwhile, industrial and agricultural energy demand in Sub-Saharan Africa is estimated by the IEA to grow by almost 40% by 2030. The sectors that can help reduce the continents import burden—cement and steel manufacturing in particular—require reliable and affordable power. Africa's mining sector is also set for unparalleled growth, driven by the projected boom in global demand for green minerals.

And yet, utilities from Malawi to South Africa have instituted indefinite load shedding after delaying critical infrastructure upgrades for years. Distribution companies from Ghana to Kenya are proposing rate hikes of up to 20% to continue funding unreliable energy service delivery.

Most African utilities are loss-making and unable to maintain existing assets or invest in new ones. To plug the gap, African treasuries are forced to use public funding that could instead be spent on health care or education.

In response, resourceful African industrials have doubled down on their traditional strategy of self-generating the power they need. The IFC estimates that privately owned diesel generators account for approximately 135 GW of power in Sub-Saharan Africa, or about twice the regional grid capacity (excluding South Africa). Customers spent nearly US$20 billion a year on fuel alone for their back-up generators.

The prohibitive costs of diesel generators and the steady push for decarbonization are encouraging businesses to adopt a different distributed energy resource: solar arrays. Electricity supplied from renewable energy technologies—particularly solar energy—is often cheaper than grid-supplied energy. When combined with storage solutions, renewable DERs can be made more reliable than what is on offer from the national grid. By “going green”, African business leaders are simply taking more control over their energy supply, through the cheapest means available.

The prospect of affordable distributed generation replacing costly diesel self-supply, has understandably alarmed some centralized power providers that are already in financial straits. In this fast-evolving landscape, energy regulators in almost all African countries find themselves called upon to deliver competing objectives: hold back the market forces driving distributed energy resources for long enough to revitalize insolvent centralized electricity suppliers, all while extending customers access to fairly priced, accessible electricity.

The utility death spiral in Africa has accelerated to a critical point. Cynics say this is a breaking point. At CrossBoundary Energy (CBE), we see an opportunity for evolution. The speed, and degree, of Africa’s sustainable economic transition will ultimately be set by how policymakers adapt their markets to the emergence of distributed energy resources (DERs).

Put simply, African economies must adopt DERs, or they will become uncompetitive as businesses choose to go elsewhere. Our experience developing these projects across the continent has given us an insider’s view of how dozens of countries are moving through this transition, as well as the opportunities and challenges they face at different stages of their journey.

For instance, some are adopting a more customer-centric and integrated market approach, and in these markets the private sector is demonstrating the value that DERs can provide, namely: alleviating pressure on the grid, and expanding industry's access to reliable, affordable power. Embedded, but distributed, projects are feeding surplus, clean power into the grid, while companies are offering new solutions to grid stability issues. DERs are even funding network upgrades by delivering long-distance, wheeled power to multiple commercial customers. Forward-leaning utilities are innovating and building for the future, introducing electric vehicle fleets and/or rolling out internet services to commercial customers. Contrary to popular wisdom, innovation and collaboration in the energy sector is emerging.

In this White Paper, we will propose an Africa-centric framework for regulators and energy sector leaders to examine each other's experiences of integrating distributed energy resources into a future-facing energy sector. We will provide a view of the options available to energy sector leaders and utilities, which form the basis of new strategies to integrate DERs into electricity markets.

Wherever possible, CrossBoundary Energy has brought to bear our direct experience of designing, financing, developing, building, owning, and operating distributed generation projects across Sub-Saharan Africa. As one of the first and largest dedicated commercial and industrial solar developers on the continent, we have been at the forefront of regulatory engagement to increase businesses' access to reliable, affordable, clean energy.

CrossBoundary Energy was also one of the first companies to successfully license solar power purchase agreements (PPAs) for our clients in Kenya, Ghana, Nigeria, Somalia, and Sierra Leone. Additionally, we are actively engaging regulators in many other markets including Rwanda, Egypt, Uganda, Tanzania, Botswana, Tunisia, Guinea, Mali, Uganda, Mozambique, the DRC, South Africa, and Zimbabwe. In each of these markets, we have studied the regulatory environment and specific legislation, regulation, and policy that may impact the benefits DERs are able to offer businesses and the national economy.

The stages of DER policy evolution we have observed and will explore as part of this White Paper are as follows:

Stage 0

Centralized Control

Markets that are largely closed to DERs and governed by command-and-control regulation. Integrated energy planning is limited. Though an independent energy regulator may have been established, there is a high degree of utility involvement in energy policymaking

Stage 1

Cautious Co-existence

Markets that are defined by incentive-based regulation. Regulators and governments are starting to study the DER market as the first projects move forward. More sophisticated energy planning is occurring, though the State continues to intervene unpredictably. Opaque initial rules can result in an uneven playing field for market participants

Stage 2

Directed Benefits

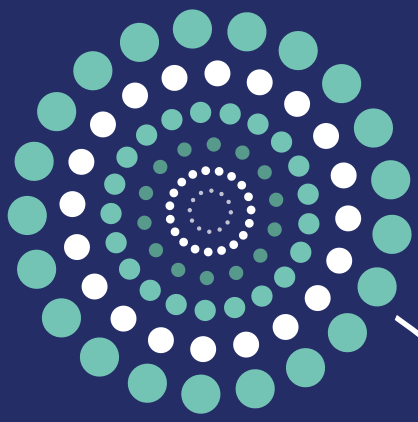
Markets in which there is regulatory predictability, independence, and a fairer playing field on which DER projects are being developed. Robust and accurate data collected by regulators about the sector starts to influence policy design. This wealth of technical information, when shared with DER providers, enables the State to consider how to allow the nascent market greater freedom to operate—within boundaries. Integrated energy sector planning is becoming more sophisticated, and utilities are accounting for innovation. Regulators and governments still play an active role in overseeing DER investment and directing its benefits

Stage 3

Early Market Management

Market-based regulation is being explored. DERs are more fully integrated into the electricity supply industry. The market is starting to direct benefits, instead of the State or regulators. Through participation in regional power trading, aggregation of DERs, and providing open access to transmission infrastructure, regulators are learning lessons to prepare for a transition to wholesale energy markets.

Proposed stages of Distributed Energy Resources integration in African energy markets



STAGE 03

Early Market Management

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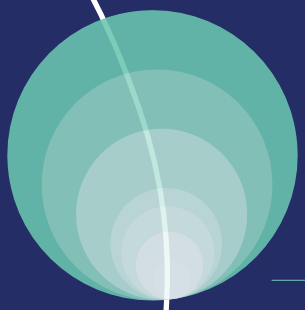

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Directed Benefits

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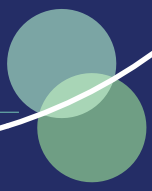
STAGE 00



STAGE 01

Cautious Co-existence

Markets that are defined by incentive-based regulation. Regulators and governments are starting to study the DER market as the first projects move forward. More sophisticated energy planning is occurring, though the State continues to intervene unpredictably. Opaque initial rules can result in an uneven playing field for market participants.

The case examples we explore across each of these stages are playing out in real time. In this White Paper we will identify the key policy and regulatory building blocks of integrated, DER-inclusive, energy market development. We will look at the actions African regulators and policymakers are taking as examples of these principles in practice. We also will highlight the actions that are impeding or even reversing sector evolution and blocking countries from extracting the benefits from DERs.

By drawing lessons from their counterparts at similar levels of energy evolution, the continent's energy policymakers can act more like physicians: they can diagnose the problem accurately and prescribe the right treatments at the right time to gradually introduce a new, healthier state of being. In doing so, they can contribute to a more stable and economically vibrant Africa.

Thank you to our contributor to this paper:

> *"Distributed energy resources (DERs) powering industry is one of the most exciting and understudied trends in the renewable energy space in Africa today. CrossBoundary Energy's pioneering work in the field provides a unique opportunity to catalog learnings driven by active market shaping. These learnings should be of critical interest to regulators, governments, industry, and researchers tracking the fast-changing energy dynamics on the continent. As the private sector takes an increasingly prominent role in Africa's energy security, unpacking the differentiated pathways towards the energy landscape of the future will be critical to fostering a just transition that promotes rapid and sustainable economic growth."*
>
> **Samuel Miles,** Renewable and Appropriate Energy Lab, UC Berkeley

Sam Miles is a doctoral researcher in Dr. Daniel Kammen Renewable and Appropriate Energy Lab (RAEL) within UC Berkeley's Energy and Resources Group. His research focuses on using novel technologies to accelerate justice-centered electrification pathways, most recently through monitoring the quality and reliability of the decentralized grids powering medical facilities across North Kivu Province, eastern Democratic Republic of the Congo. An interdisciplinary scholar, Sam is supported by the National Science Foundation and Link Fellowship. Outside of energy research, Sam has a background in management consulting, technical writing, and entrepreneurship. He is fluent in French and English with a Master's from Sciences Po Paris and a Bachelor's from Yale.

Building blocks of DER-integrated electricity markets

Advice to African policymakers and energy regulators on the integration of distributed energy resources (DERs) often lacks appropriate context and nuance. Recommendations for new regulations are not sufficiently defined by *when* they should best be introduced. Suggestions for policy reforms often fail to recognize the structural dynamics of specific energy markets or the way in which sectors are being governed.

This White Paper hopes to break this trend by providing concrete guidance to policymakers, regulators, and energy sector officials on which policy building blocks should be selected and deployed at different stages of electricity market evolution. Maximizing the benefits while controlling the risks of DER integration, rests on using the right tool for the problem and doing so at the right time.

We use case studies to illustrate the stages when certain regulatory reforms are most practical. Our focus is on the African context, where the stakes for effective DER integration are highest and where regulators are most hungry for more targeted, relevant advice. To provide actionable ideas to energy sector leaders, we have focused on the policy elements we consider to be most important.

Further work will of course be required to adapt these principles to the specific sector and governance realities of individual markets. It is our hope that this publication and the White Paper that follows will trigger healthy sector discussion about these "next steps."

We also welcome further debate about where policy for DERs has succeeded and where it has fallen short. We would especially like to hear from those closest to the challenge of providing more reliable, affordable energy for African industry.

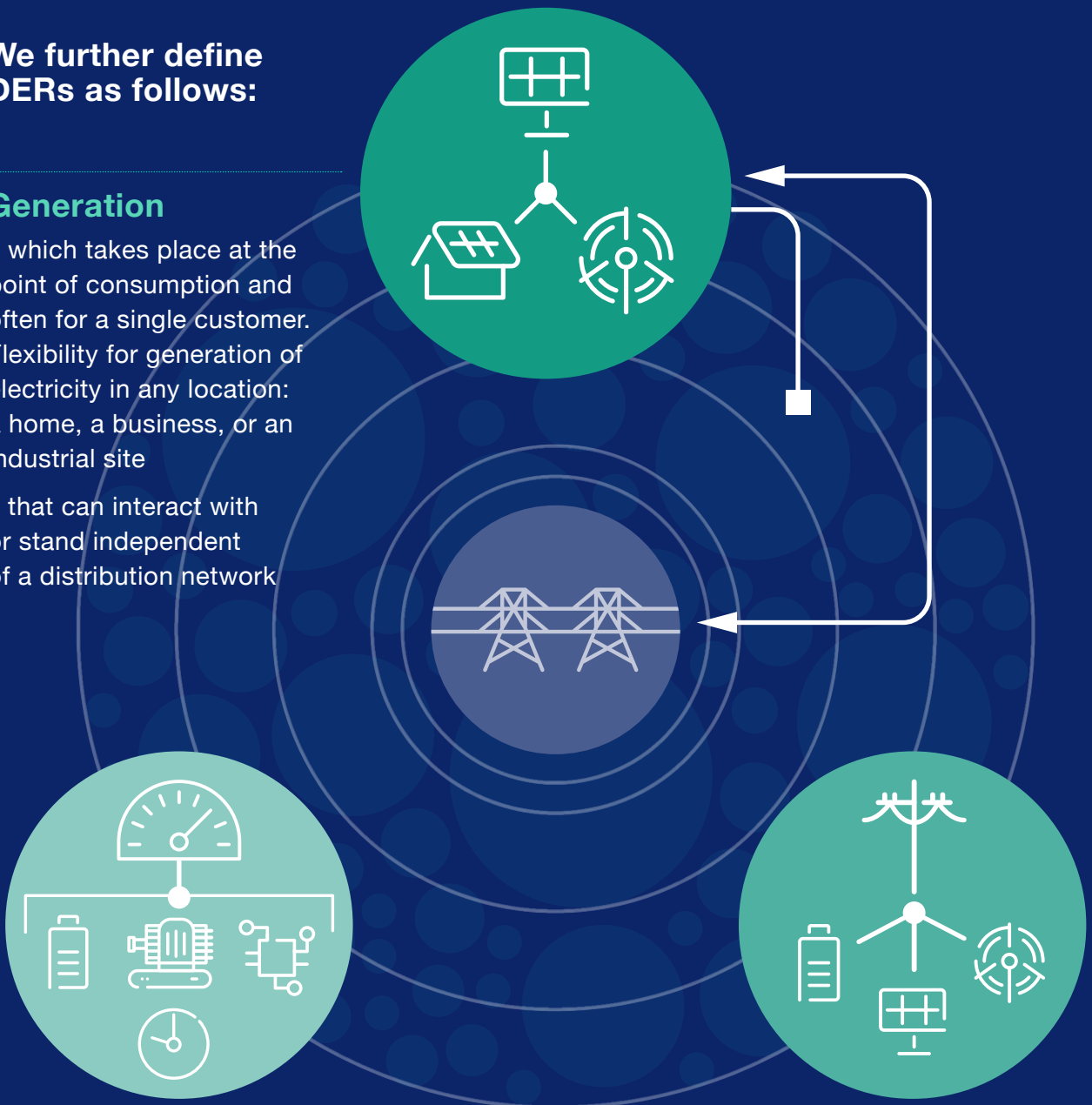
In this White Paper, we consider distributed energy resources (DERs) to be generation in all forms and in all sources that is owned and operated by a private entity. These resources may include but are not limited to electric storage resources (thermal and renewable), distributed generation (both thermal and renewable), and energy efficiency applications.

We further define DERs as follows:

Generation

– which takes place at the point of consumption and often for a single customer. Flexibility for generation of electricity in any location: a home, a business, or an industrial site

– that can interact with or stand independent of a distribution network



Captive power projects

– which are not connected to the local distribution network and are often termed “behind-the-meter” and defined as follows:

Additional private sector DER investments to support customer-side power management. Often include shifting time of use to reduce bills, installing energy management systems to optimize energy use and installing battery energy storage systems (BESS), or in some cases generators, to provide backup power

Embedded power projects

– are another form of DERs, though defined as small-scale production of power at a ‘local’ level, through connection of electricity generation or storage plants to a distribution network. Notably, the connection is to the low voltage network

For the purposes of this White Paper, we will *exclude* from our definition other forms of DERs including electric vehicles and their charging infrastructure (including vehicle-to-grid), mini-grids and solar home systems (SHS), energy efficiency measures like smart thermostats, and thermal energy systems like ice storage. While these are important technologies for the global energy transition, our focus is on clean energy for the purposes of green industrialization and broad-based economic growth.

The benefits of DERs, or distributed generation (DG), were well defined by the US Federal Energy Regulatory Commission and the Department of Energy (DOE). A series of papers outline the benefits of integrating DG into the modern electric system. These include supplementing grid power supply during periods of peak demand, improving power quality, and providing ancillary services.

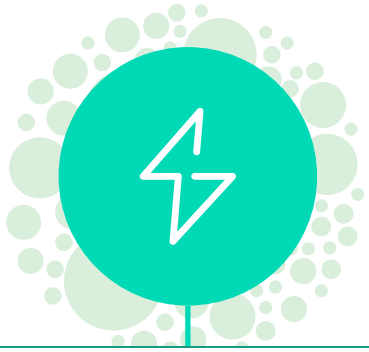
In an African context, DERs generation can deliver significant benefits to multiple market actors:

For policymakers

If the regulatory environment is conducive and permitting and licensing projects is undertaken efficiently, DERs can be delivered more quickly than utility-scale projects and at little or no cost to government. Even larger-scale (>50 MWp) projects can usually be installed and operationalized within 12-18 months. As a result, renewable DERs can make a notable contribution to national renewable energy targets. As industry gains access to affordable, reliable, clean energy, DERs can also help governments demonstrate real commitment to green industrialization. Making more affordable energy available to leading industries can help boost manufacturing output, local employment, and eventually tax receipts

For businesses

DERs can supply remote communities or businesses with reliable power in a far more cost-effective way than expanding or reinforcing grid infrastructure. This can help reduce energy losses by reducing reliance on centralized power plants and transmission and distribution infrastructure. When sufficient technical planning is undertaken to manage the integration of intermittent renewable energy sources into electricity grids these new technologies can even help improve voltage control and management. One example is known as “peak shaving” in which DERs can help to reduce or “shave” grid load during peak hours as DER-users are no longer drawing electricity from the grid. This helps improve overall grid reliability. Alongside potential benefits, we do recognize the risks that utilities need to manage when integrating DERs into electricity markets, and we have provided more detail on the work required here in the latter part of this White Paper, under Stages 2 and 3



For utilities

When intermittent renewable technologies are combined with on-site storage, uninterrupted power generation becomes one of the essential benefits of DERs. This 24-7 reliability is critical for many businesses, particularly for telecommunications and mining and metals industries. For many users this marks a shift from vulnerability brought about by events and accidents that cause centralized grid down-time (outages) or voltage fluctuations. Additionally, the cost savings typically associated with DERs and distributed generation can lead to increased production and operational expansion. DERs replacing polluting diesel generation can also offer a route to decarbonization for energy-intensive sectors such as mining, and cement or steel manufacturing. Lastly, progress on carbon reduction targets helps to favorably position businesses in an investment climate which increasingly favors environmental responsibility

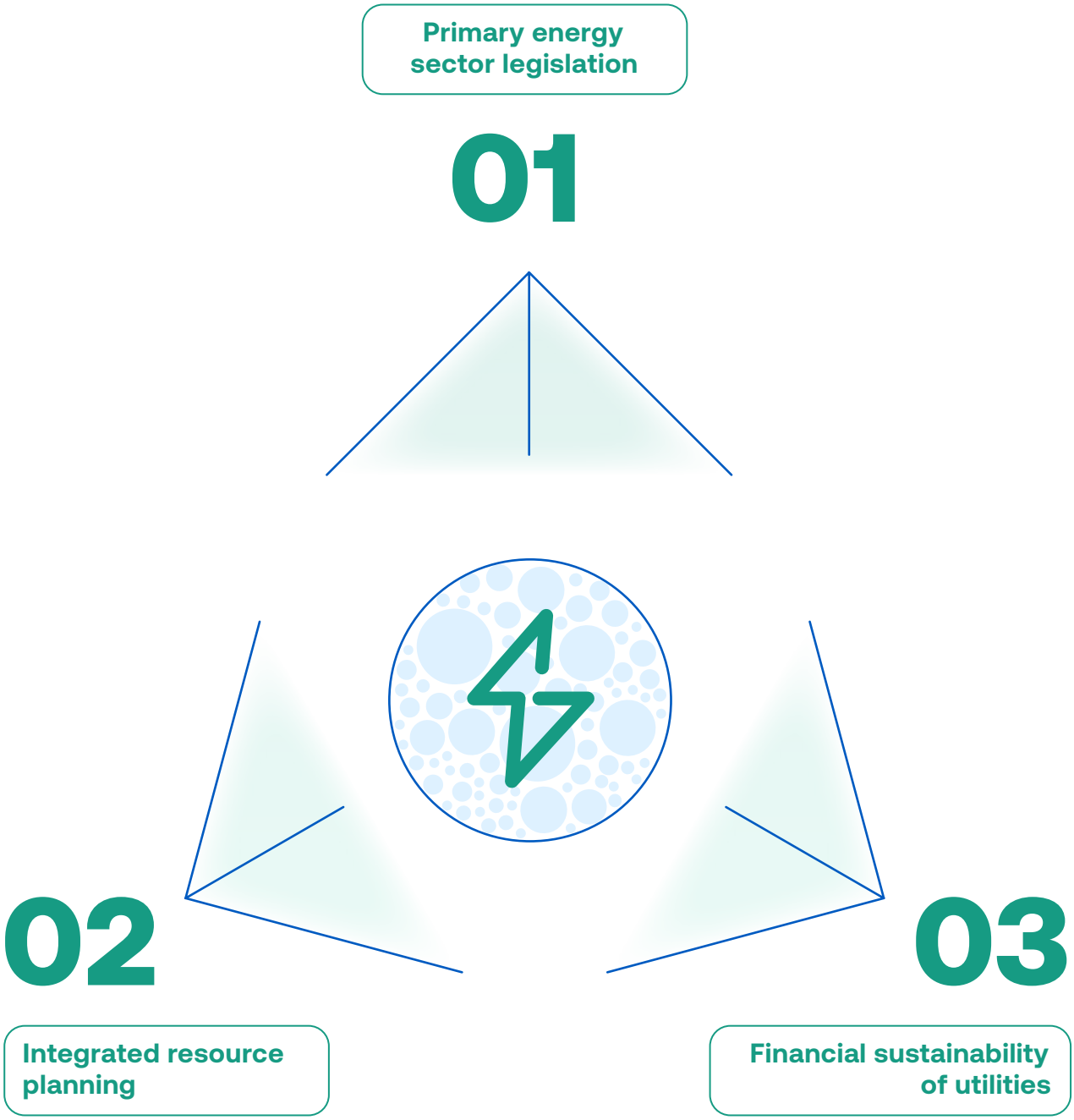
So, what building blocks must be in place to realize these benefits and control for any risks?

There are three cornerstones of energy regulation which must be considered at any stage of this journey:

Primary energy sector legislation establishes a market's structure and dictates the rights and responsibilities of sector entities. Changes to primary legislation take time to develop and enact as they usually involve significant work of both the legislative and executive arms of government. Once enacted though, primary legislation can dramatically change how an energy sector is governed while expanding the role the private sector is afforded.

Integrated resource planning is crucial for all countries looking to build modern energy systems and transition away from fossil fuels. When done well, policymakers ensure that long-term sector planning accounts for all aspects of energy demand and supply. Data-driven forecasts allow energy planners to calculate trade-offs and determine the most cost-effective approach to meeting energy needs. Effective integration of DERs is greatly benefited by robust and accurate integrated energy planning.

Financial sustainability of utilities. When utilities are underperforming, the temptation to hold back DERs will be stronger—as was the case in Ghana and Senegal when short-term PPA moratoriums were imposed to the detriment of industry and renewable energy targets. In Uganda by contrast, Umeme's strong balance sheet helped introduce new regulatory space for DER projects. Uganda's new Electricity Law amendment (2022) introduced private sector participation in generation and distribution of electricity and effectively rolled back the utility's monopoly in rural areas. As DER penetration increases in any market, it is crucial that reforms aimed at improving the financial sustainability of utilities are happening in parallel. The World Bank underscores, for example, tariff adjustments, reduction of technical and commercial losses, and improvements in metering and billing collection as examples of what has worked in public utility reform. Financially viable utilities are in a much better position to make way for DERs and the benefits they provide.



Primary sector legislation, integrated resource planning, and utility performance and viability impact DER integration in any market. They are therefore foundational. As African energy markets evolve, however, the choice of additional building blocks which regulators can deploy widens significantly. Through informative country case studies, we will consider this range of policy and regulatory instruments. In this White Paper will provide suggestions on when they should be deployed in order maximize DER benefits while mitigating the risks presented by increased DER penetration.

Stage 0

Centralized Control

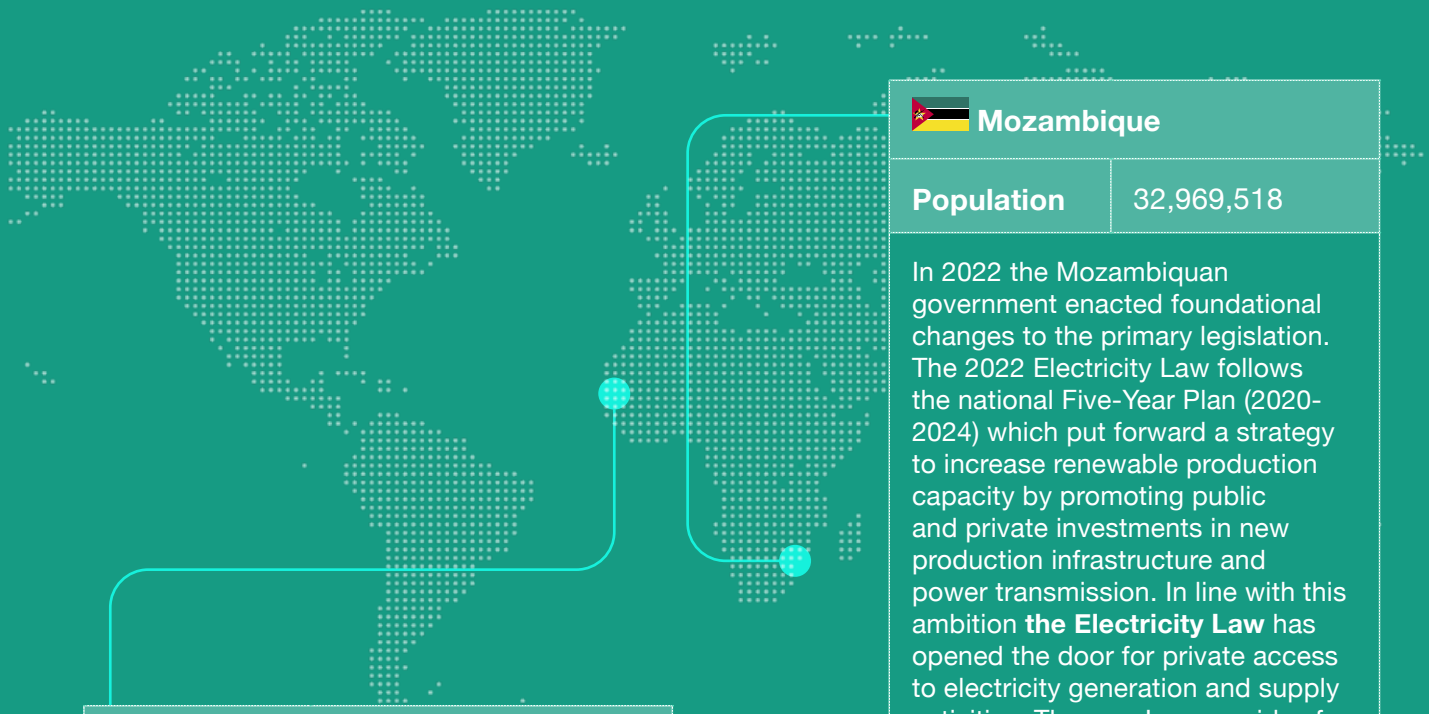
Several African markets currently lack the regulatory environment to take much advantage of the benefits of DER technology. At this Stage, the State sees its paramount objective to be controlling for the risks that it believes could be created or heightened with the introduction of distributed energy resources. In some markets, cheap hydropower or gas is readily available, so businesses do not suffer from restricted access to affordable energy.

In CrossBoundary Energy's experience, however, modern renewable DERs are mostly absent from a market because governments have explicitly blocked them. Seeking definitive mitigation against the risks of oversupply, grid defection, and central grid insolvency, the State denies easy access to affordable, renewable DERs. Where energy supply power remains unreliable, customers still revert to DERs for on-site generation needs. However, instead of renewable on-site generation, they are restricted to expensive and polluting diesel generators. Investor interest in alternatives is discouraged by policy emphasis on central control of all power resources.

Countries at Stage 0 are most likely governed by a command-and-control form of regulation. UNIDO defines this form of energy regulation as being drawn up "in response to specific areas of concern (and) often in a short time frame." As UNIDO notes, regulation is rarely drafted and enacted as a result of deep economic analysis or comprehensive market studies. Instead, as they grapple with the multitude of challenges facing centralized energy utilities, policymakers restrict the growth of DER projects.

Moreover, there is often limited engagement between private sector actors and the policymakers, who therefore often have limited appreciation of the potential sector benefits of DERs. The response to curtail DERs is on one hand understandable, given the competing interests governments are striving to balance. Unfortunately, it rarely solves the challenges facing centralized utilities, and therefore the utility death spiral continues. In the long term, the downside of blocking DERs—industry losing out on clean, reliable energy—outweighs any upside.

Case Studies - for Stage 0



Senegal

Population	17,316,448

Senegal is at this early stage of distributed energy resource market integration. Senegal has one of the highest generation costs in Africa, and the US International Trade Administration **points to a 10-14 cents per kilowatt hour gap** between average electricity generation cost and the tariff paid by customers. This gap has been bridged by government subsidies on the cost of power which, in turn, has put strain on the national utility, SENELEC. In grappling with this challenge, Senegal's Ministry of Energy placed a temporary moratorium on third-party financing of renewable DER projects. Customers currently have no recourse to on-site generation, except by self-financing a costly asset. As is also typical of command-and-control regulation, exemptions to the restrictive regime have so far only been provided by central Government entities.

Mozambique

Population	32,969,518

In 2022 the Mozambiquan government enacted foundational changes to the primary legislation. The 2022 Electricity Law follows the national Five-Year Plan (2020-2024) which put forward a strategy to increase renewable production capacity by promoting public and private investments in new production infrastructure and power transmission. In line with this ambition **the Electricity Law** has opened the door for private access to electricity generation and supply activities. The new Law provides for self-generation of electricity through distributed generation and exempts production for self-consumption from a concession. This is a major accomplishment which will set the foundation for future evolution of the energy sector.

However, as the recent Electricity Law is broadly targeted at utility scale projects it imposes onerous, expensive, and restrictive concession regime conditions for any renewable energy projects utilizing third-party ownership (for example through a power purchase agreement). This requirement effectively stifles any meaningful development of the market for PPA-backed DERs as it assigns the same regulatory framework to DERs as utility-scale projects. The lack of dedicated DER policy effectively prevents third-party financing of DER's; businesses looking to auto-produce power need to use on-balance sheet arrangements. This ties up funds that could otherwise be used on expanding their operations.

Recommendation for policymakers and regulators

To advance to the next Stage of integration of DERs into the wholesale electricity market, we recommend that regulators clearly prioritize establishing a dedicated DER policy. They should also work closely with Ministries and utilities to ensure downstream buy-in for the policy.

Overall, progress towards development of discrete regulation for distributed energy resources in Africa is progressing, as is outlined in the 2022 African Development Bank (AfDB) Electricity Regulatory Index (ERI). The latest ERI report found that a clear licensing framework for decentralized systems has been established in all but one of the countries in the 2022 sample. Gabon is the sole exception to this continent-wide progress.

It is also worth noting that in 28 of 42 markets analyzed by the ERI, the licensing framework was established by an independent regulatory agency. Many of these frameworks, however, are focused on licensing of mini-grids and solar home systems. More work is needed on national frameworks for licensing larger-scale DERs.

When approached by developers seeking to deploy DERs, regulators without DER-specific rules to guide them often default to laws and regulations that have been established and designed to govern utility-scale projects. Historically, utility-scale generation has been the first sub-sector of the electricity landscape to open to private sector participation. These regulations are however typically inappropriate for DERs. They are often onerous, requiring lengthy and cumbersome licensing. In some cases, participation or concession fee requirements designed for utility-scale projects undermine the viability of smaller-scale DER projects.

We believe that distinct regulation is needed given DERs typically differ from utility-scale projects in the following important ways:

Private contracts which providers are competing for. Unlike utility-scale projects, the contracting parties for DERs are typically two commercial, private entities. Given no domestic customers are party to the contract, there is no need for the State to act on their behalf by overseeing public tenders. Equally private commercial entities should be free to choose what they pay for their electricity, and competition between providers of DER solutions will automatically drive tariffs down. Instead of approving tariffs, the State and regulators should ensure that rules foster and enable competition, creating

a level playing field for multiple DER providers to operate within the market. This will allow customers the freedom to choose solutions suited to their specific energy needs.

No use of public infrastructure. Similarly, DERs do not typically make use of public infrastructure or land. Developers typically deploy solutions on the customer's premises and renewable energy solutions connect directly to their facility. Financial reimbursement to the State or utility is therefore not appropriate as no public infrastructure is utilized. In the case that DERs do connect to, or supply energy to, the national grid, standard interconnection processes should apply. These requirements and specificities should not be the focus of this Stage however, where a dedicated DER policy first needs to be introduced.

Minimal grid impact at lower penetration levels. Grid impact studies show that while behind-the-meter renewable energy solutions do have an impact on the grid in terms of availability of power to cover any intermittency, this effect is minimal for individual behind-the-meter plants at lower penetration levels. Impacts will however be amplified on parts of a network where there is high DER penetration or larger DER plants, especially if no storage solutions accompany the intermittent renewable energy plants. We will cover these challenges later in this White Paper.

Given the distinct nature of DERs, regulators should consider the following aspects in establishing bespoke regulation and policy:

Suggested requirements for initial dedicated DER policy

While neither Senegal nor Mozambique have yet established dedicated DER policies, work is underway to provide a targeted policy framework for these solutions. Through these efforts, these two markets will hopefully progress toward the next Stage of DER market integration.

Senegal

In Senegal the private sector is awaiting a series of decrees and Ministerial orders—expected in 2025 when SENELEC'S monopoly will end—that will, hopefully, clarify the conditions under which an independent power producer (IPP) can sell renewable power to private customers. New rules will establish which customers are deemed eligible for self-generation. This regulatory progress will start to unlock the market and ensure that benefits being derived from the DER sector are directed more evenly.

Mozambique

In Mozambique the Ministry of Energy is considering a streamlined concession model for on-site, renewable energy projects. The National Department for Energy (DNE) is examining the treatment of mini-grid projects (a smaller-scale DER) which may provide a useful precedent for consideration of larger-scale captive energy projects. If piloted and developed into specific regulatory guidelines, Mozambique will start—like Senegal—to transition to the next phase of DER market development. It is this Stage, "Cautious Co-Existence", that we will examine in the next series post.

In conclusion...

To secure the benefits from DERs, energy sector leaders and regulators must acknowledge the existence of DERs as a potentially complementary part of the energy system. Allowing commercial and industrial customers to go their own way with self-generation is simply permitting the status quo. Whilst new technologies can introduce complications, by excluding them, regulators will only allow existing problems to fester. At this point, what we recommend is explicit recognition of DERs as a separately regulated class of energy resources.

Stage 1

Cautious Co-existence

Definition of this stage

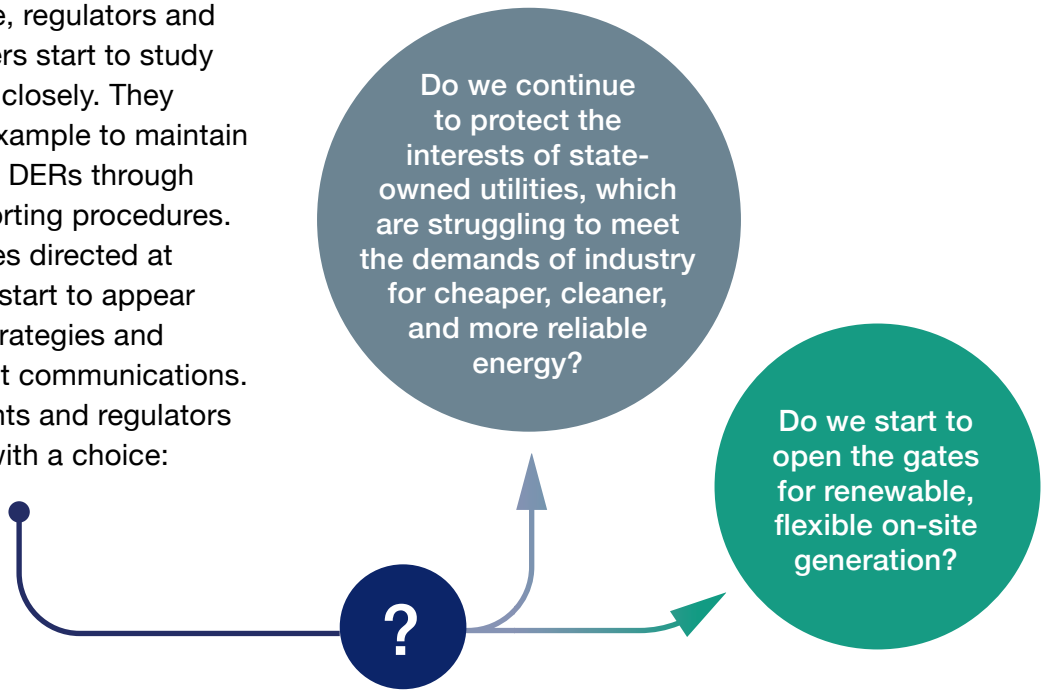
Once policymakers start to create regulatory space for the emergence of DERs, new investors and DER providers are likely to enter the market. Their increased certainty in securing regulatory compliance is coupled with confidence that projects will meet their return expectations.

Amidst the growth in activity, industrial groups and associations begin to organize collectively to make clearer demands for the right to self-generate cheaper and cleaner energy. Consumers are motivated by the simple but unavoidable reality that centralized power is expensive and less reliable than private power. Industrialists dare to imagine a future without polluting, expensive diesel generators.

Building on a dedicated DER policy and/or regulation, at this Stage, the private sector starts advocating for nuancing and streamlining of licensing procedures. Leading DER providers begin pushing for lighter-touch requirements and shorter statutory timelines. Requests may arise for clarity on the roles and responsibilities of relevant ministries, departments and agencies involved in regulating DERs.

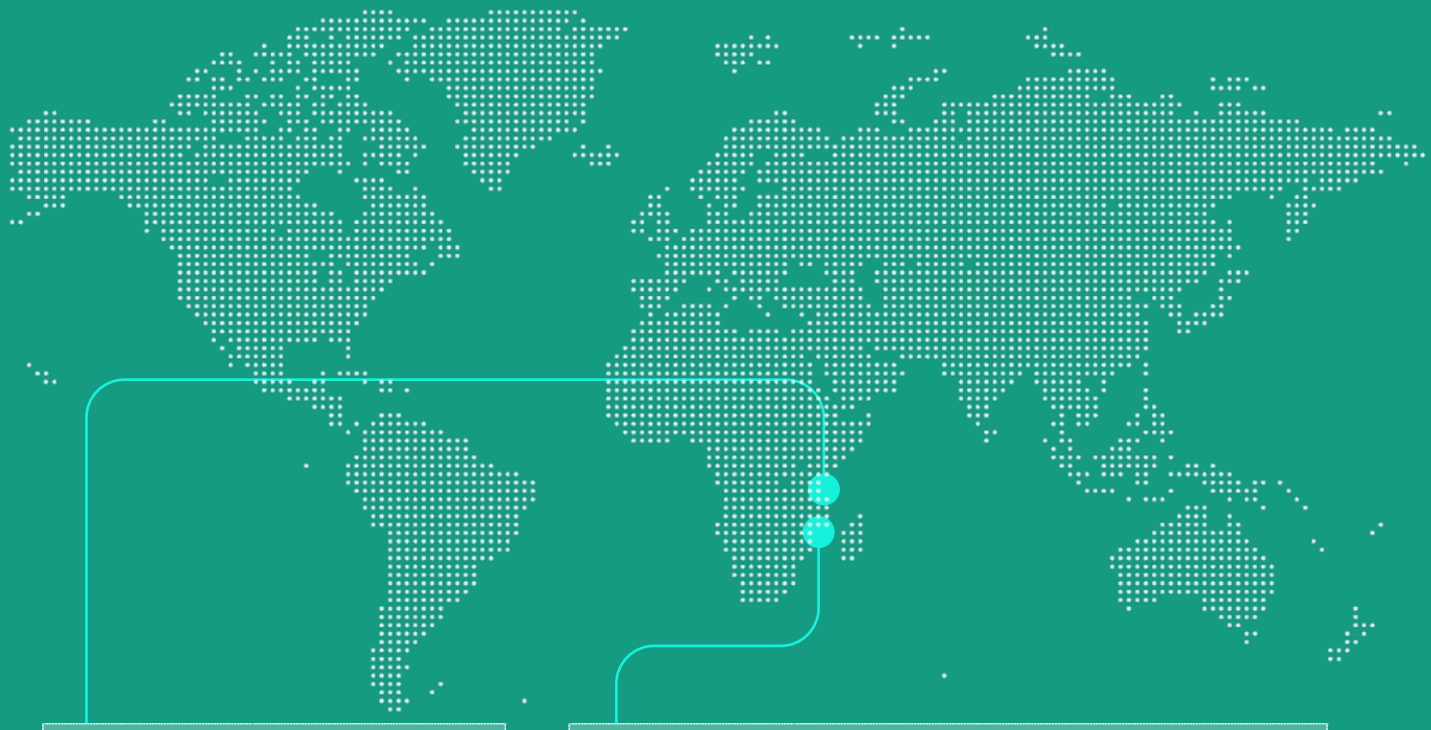
Actions by regulators and governments in shaping the emerging market become increasingly relevant at this stage. Representatives of the state-owned utilities may start to signal “grid defection” concerns, forcing policymakers to take first notice of DERs and the role they are playing—and could play—in the wider energy sector. Looking to capitalize on policymaker interest and growing offtaker demand, leading DER providers seek to further familiarize policymakers with their flagship projects.

In response, regulators and policymakers start to study the market closely. They begin for example to maintain registers of DERs through formal reporting procedures. New policies directed at DERs may start to appear in sector strategies and government communications. Governments and regulators are faced with a choice:



At this Stage, dedicated teams are often established within energy regulatory agencies to oversee the integration of DERs. In general, the mode of regulation at this stage—at least for the DER sector—can be categorized as incentive-based. The defining feature of incentive-based regulation is the use of rewards and penalties to induce desired goals, where the utility (or in this case private energy suppliers) are afforded discretion in the manner of achieving these goals. A well-known example from the global energy sector is regulators setting performance standards for distribution utilities and benchmarking companies based on connection downtime and safety standards.

Case Studies - for Stage 1



Kenya

Population	54,027,487

In Kenya, the public-private collaboration which marks Stage 1 has been advanced through formation of a commercial and industrial generation working group under the national energy sector association (ESAK). The 'C&I Working Group' suggests policy and regulatory improvements to the national energy regulator (EPRA). Their input is focused on improvements to scale private sector investment. The sector association champions the role of DERs in the sector through improved use of data and marketing. Baseline studies and reports have been commissioned with the implicit backing of the national regulatory agency, EPRA. The results of these studies help to tell a story of a sector being transformed.

Tanzania

Population	67,943,663

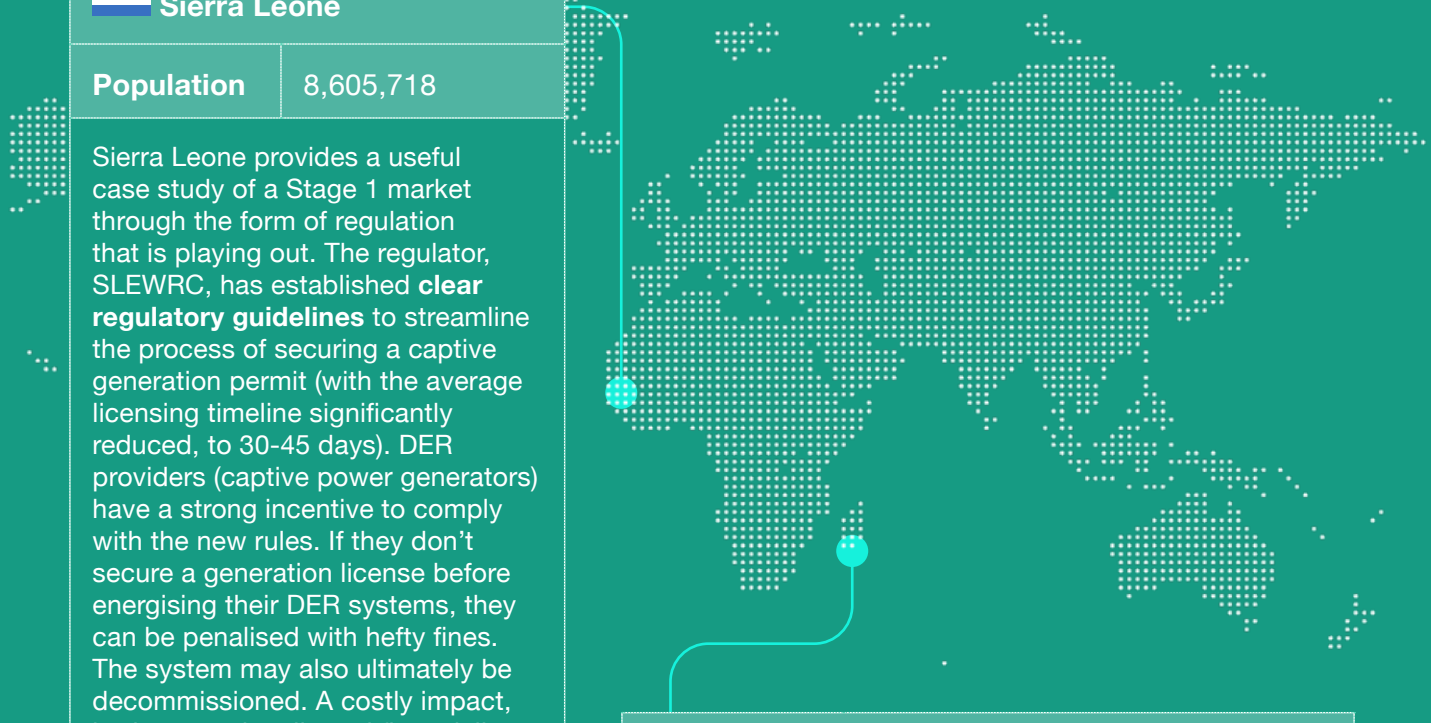
Tanzania is an interesting case study at this Stage as there are clear signs of cautious co-existence of DERs alongside centralized generation. While existing regulation provides room for investment in and development of DERs for private businesses, only a small handful of projects have been licensed under a power purchase agreement (PPA) structure. The energy regulator, EWURA, has established eligibility criteria that limits the number of businesses that can take advantage of third-party financing **(Electricity Rules, 2019)**. Only customers that are connected to the national grid at 33kV are deemed "Eligible Customers", thereby allowing the seller of electricity to apply for a generation license. As most commercial and light-industrial (C&I) customers remain connected at 11kV or lower, these businesses can only take advantage of DERs under an EPC contract in which ownership of the solution remains with the customer. In these instances, third-party financing through a PPA is essentially disallowed. Tanzania's cautious approach of permitting DER self-production for a designated segment of customers is nonetheless an important building block on the path to increased DER integration. We welcome further broadening of the existing eligibility criteria, which would justify a move into Stage 2.

Case Studies - for Stage 1...continued

Sierra Leone

Population	8,605,718

Sierra Leone provides a useful case study of a Stage 1 market through the form of regulation that is playing out. The regulator, SLEWRC, has established **clear regulatory guidelines** to streamline the process of securing a captive generation permit (with the average licensing timeline significantly reduced, to 30-45 days). DER providers (captive power generators) have a strong incentive to comply with the new rules. If they don't secure a generation license before energising their DER systems, they can be penalised with hefty fines. The system may also ultimately be decommissioned. A costly impact, both reputationally and financially. The energy service supplier can use discretion as to whether they comply or not, but there are clear rules and a level playing field. These licensing improvements and others in Sierra Leone have helped to ensure that over 60MW of captive generation systems have now been licensed by the national regulator, SLEWRC.



Madagascar

Population	29,611,713

Madagascar's self-generation regulations **(2017)** show elements of a Stage 2 market. In a form of streamlining, licensing thresholds were established in line with economic realities. Smaller solar PV projects (<500kWp) are only subject to a declaration process. A formal autoproduction license granted by the Ministry of Energy applies to solar PV projects above that threshold. Recent 2022 regulations establish standard forms for these applications across all technologies.

Providing the ability for DER providers to supply excess power to the grid is typically a feature of more highly integrated DER markets, yet Madagascar has provided optionality for net metering since 2017. Nonetheless the way net metering has been introduced demonstrates a "Cautious Co-Existence" approach. Only 4% of annual production is permitted to be sold by an auto-producer to the network, in exchange for net metering credits. The terms, commercial conditions and feed-in tariffs for the surplus renewable energy are also fixed by the regulator ARELEC. We commend Madagascar's regulator and Government for creating an opportunity—albeit controlled and limited—to study the impact of net metering from DER projects to help bridge the country's energy deficit.

Recommendation for policymakers and regulators

A thought-proving paper by the US National Renewable Energy Laboratory (NREL, 2012) proposed a set of policy pathways for the scale up of DERs. The framework the NREL authors proposed helped to inspire this White Paper. Their paper describes this Stage as one in which the State is focusing on "removing legacy or institutional barriers to ease implementation of advanced technologies." In CrossBoundary Energy's experience, the most valuable way to remove such legacy and institutional barriers is by focusing on improvements to the licensing and reporting regime. The changes we believe which best help transition a market to Stage 2 are as follows:

Removing barriers by streamlining licensing:

- Ensuring that regulators—or the relevant Ministries, departments, and agencies of government—meet codified statutory timelines established in Stage 0. Regulation in practice reflects regulation on paper.
- Broadening or removing eligibility criteria. These rules are usually intended to slow the development of DER projects. Removing them signals progress towards Stage 2.
- Maintaining a level playing field in the payment of licensing fees, including at sub-national level (for example from physical planning offices in County Governments). Where interim permits are required from sub-national government bodies, formalizing alignment between federal and local legislation prior to implementation.
- Improving timelines for environmental permitting. This should be of particular focus when environmental permits are provided by federal Ministries.
- Ensuring that once projects are licensed and operational there is an established process for reporting on project performance.
- Developing and implementing an appropriately robust focus on health and safety:
  - Putting in place a process to monitor performance; and
  - Discrediting suppliers who are not providing a good service, to protect customers.

- Streamlining communication on any changes to standing licensing procedures by issuing formal sector notices. This ensures transparency and provides regulatory clarity.

- Exploring ways for licensing thresholds to reflect economic realities. For example, providing exemptions for smaller DER projects, to reduce the burden on the small businesses seeking reliable, affordable on-site generation. A declaration process can also replace licensing for smaller projects.

- Updating regulations and guidelines consistently, including to reflect any changes in primary legislation.

In Africa the licensing improvements that define this Stage must largely be undertaken first at the federal level. **Nigeria** is however providing an interesting opening for nascent State-level regulators to elaborate upon, refine, and improve national DER regulation. Nigeria's 2023 Constitutional Amendment has given way for State-level electricity planning and regulation. This builds on federal progress in DER investment and development, driven by significant demand for cleaner, affordable power to replace thermal backup power for industry. States like Lagos and Oyo are furthest along in establishing priorities and plans for utility-scale generation transmission and distribution improvement and off-grid electrification. There is therefore an exciting opportunity for these States to lead the way in taking on board some of the Stage 2 recommendations of this paper.

Once these modifications have been made to the licensing regime—at either the federal level or in line with decentralisation—governments should focus on starting to gather relevant data on the DER sector to allow for subsequent market mechanisms to take shape. Regulators may consider digitizing the collection of relevant data, as Ghana's Energy Commission (EC) is currently doing. The EC's introduction of data logging equipment on selected solar PV installations will support the development of a nationwide database on renewable energy resources. These data-driven interventions by policymakers will also allow for a deeper understanding of the technical and commercial realities of DER deployment in Ghana's energy market.

Another way in which regulators can gain data-driven insights is by holding consultations with leading DER providers. Through a transaction-focused approach, regulators can learn about how certain regulatory restrictions are impacting project viability. A good example is how the government of Egypt

engaged CrossBoundary Energy and other developers to increase the threshold for applicability of a grid integration fee. We wrote about this process in detail here. It is a good example of how energy leaders can familiarize themselves with different types of DER projects and tailor policy accordingly to remove development barriers.

Overall, the “Cautious Co-Existence” Stage is marked by huge potential for a country’s businesses, as well as attractive returns for the international DER providers and investors who have the courage and experience to enter a nascent market. This Stage equally offers attractive returns and exciting opportunities for local DER providers helping to build the landscape around them, as they develop and commission first-mover projects.

It is also, however, a Stage that is prone to backslide. Countries that show signs of opening up to the potential of DERs can quicky begin to close again.

To move into the next Stage of “Directed Benefits”, and to stay there, government champions must boldly step forward and encourage their countries along the path of green industrialisation. Industry must continue to make their needs heard. DER providers must engage on regulatory reforms, rolling their sleeves up to help do the work where needed. Without dedicated commitment by all parties, the budding progress of this Stage can be undone all too easily by utility interference or policy inertia.

Stage 2

Directed Benefits

Definition of this stage

At this Stage, a DER market is taking shape. The policy mechanisms that start to emerge rely on the State and regulators collecting and disseminating robust and accurate sector data. This wealth of technical information, when afforded to DER providers, enables the State to step back and allow the nascent market to direct DER benefits.

The NREL paper we've quoted previously in this White Paper named this Stage "Market Creation." We instead use the title "Directed Benefits" as it speaks more directly to how policymakers are correctly identifying the potential gains of DERs, but still controlling how those benefits are directed. Capacity thresholds or mandates are adopted which set upper limits on total DER generation. Where interconnection to the national grid is permitted, the national utilities dictate where, when, and at what cost, this work can be undertaken. Regulatory opening yes—but also strict procedures to be followed.

In addition to addressing new complexity presented by DERs, at this Stage policymakers also gain an understanding of how DERs can fit into the wider energy landscape. They learn how DERs can productively co-exist with centralized utilities. Enabling the wheeling of power from DERs to businesses through the network, can unlock revenue for owners of grid infrastructure. Through the use of system costs, utilities can directly benefit from the increased deployment of DERs. Further benefits of DER integration like contribution to grid stability, reduced overall energy costs, and provision of surplus power become clearer and can be proven from sector data.

Utilities and regulators gain experience of how to mitigate the risk of overloading distribution networks, should injected DER capacity overwhelm technical limits. Greater penetration of variable generation from DERs requires the electricity system to become more flexible. We wrote in Stage 1 about one of the benefits of DERs being minimal grid impact at lower levels of penetration. At higher levels of penetration, and once larger DER projects are operating on the network, new complexity is introduced. It becomes imperative that the grid is effectively managed. Spinning reserve and additional dispatchable generation capacity on the grid is needed to smooth the fluctuations of intermittent renewable energy from DERs. This should be a core focus of utility leaders at this Stage.

Through the publication of sector data by energy regulators, the market starts responding and collectively proposing amendments to the rules that govern their activities. The private sector is acting with increased alignment and coordination. Transparent information about market activity enables a truly even playing field.

Case Studies - for Stage 2

Costa Rica

Population	5,180,829

Looking beyond our Sub-Saharan Africa focus of this Series, Costa Rica provides an interesting example of regulatory frameworks intended to support effective deployment of DERs. A December **2022 paper** by the US National Association of Regulatory Utility Commissioners, NARUC, highlights how the national energy regulator, ARESEP, is using a data-driven approach for deployment of DERs. NARUC underscored how ARESEP is focusing on developing technical instruments for calculating the penetration of DERs in the national energy system. This data is being used to: (i) apply bespoke network interconnection fees which are newly in line with total consumption and network capacity requirements; and (ii) supporting different distribution companies—the sector is unbundled—to agree with self-producers on clear rules for load limits per circuit and related network access requirements.

South Africa

Population	59,893,885

South Africa is the first market in Africa that we would consider to be entering Stage 2. In 2022 a competent and technical energy sector regulator, NERSA, lifted the licensing threshold for DERs in response to the generation shortfall - **estimated** by the national utility, ESKOM, to be 6GW—and persistent need for nation-wide 'loadshedding'. Due to these important regulatory changes, DER providers now enjoy streamlined licensing timelines for new projects. While these moves are noteworthy, these licensing improvements are largely work for Stage 1. What marks South Africa as fit for this Stage 2 is perhaps more mundane but no less important. It is the way data is being used to drive further integration and penetration of DERs.

One example is how the national utility ESKOM is making available grid capacity data and routinely publishing updates on grid integration interconnection queues. The private sector is, in turn, trusted to make informed decisions on where to deploy new projects based on this data. A second example is streamlining and publication of the grid integration process to encourage further deployment of DERs. The new rules changed the process from a "first come, first served" principle to "first come, first ready". While some IPPs **challenged** the new rules on the basis that long-standing projects would be adversely affected, the rules do prioritise projects that are ready to utilise capacity. In our view, demonstrated readiness constitutes a more efficient handling of the grid queuing process. Either way the publication of new rules—if uniformly applied—will support DER providers better determine project bankability by providing clearer development timelines.

USA - California **Population** 39,538,223	California is another good example of how a country can progress into Stage 2. Though California has one of the most advanced markets for DERs in the world, we find examples of how its regulators use data to still be applicable to their African counterparts. For a number of years the State utility has made available distribution system **'heat maps'** which provide important data to inform DER integration including line voltage, load, and interconnected as well as queued generation capacity. In 2016 the State also hosted a series of workshops called 'integration capacity (ICA) **proceedings**'. During the ICA proceedings engineers from three private utilities worked with DER providers to develop a shared framework for DER connection to California's distribution networks. A dedicated public-private working group was established to identify capacity limits for DER integration at different interconnection points. A second working group focused on bringing DER-provider perspectives into the annual planning of the State's privately-run utilities. The discussion points from the ICA workshops and working group meetings were made publicly available in a joint final report, allowing full-sector alignment around key issues facing DER providers in the State. As a result of the collaborative and data-backed discourse, and to effectively address network management, DER providers agreed to new requirements **in 2017** that all DERs applying for new interconnection must be fitted with 'smart inverters' to provide basic grid support functions.

Recommendation for policymakers and regulators

As our case study examples demonstrate, what is important at this "Directed Benefits" Stage is the use of sophisticated sector and network data to update existing regulatory frameworks for the integration of DERs. Utilities must lead this charge by developing a robust baseline understanding of their grid, largely through the collection of data that provides near real-time insights on the grid hosting capacity, customer demand, and end-use energy behind it.

To move into the next Stage—a fully-fledged wholesale electricity market with flexible market management mechanisms—utilities and regulators must leverage the data available to allow DERs to be deployed in the agile and stable configurations which optimize load distribution and ensure effective grid management. Trust-based collaboration must then be established between DER providers and utilities such that they can respond to this call.

In Africa, several utilities are already embracing technologies that support such data-gathering. One example is Somalia, where Power Africa has been working since 2022 to pilot SparkMeter's technology on the 20,000 customer national distribution network. Grid monitors, placed at strategic points on the network, helped the national utility to compare readings with

reported energy consumption of customers on their network. This allowed the utility to view losses in near real-time on the network. As part of a commercial roll-out of the smart meter technology, Somalia's national utility, NECSOM, could be extended to help assess network capacity challenges or to support optimisation of potentially cheaper renewable energy solutions, including DERs.

Building on these digital innovations, at this Stage African utilities and regulators must work closely with DER providers to understand exactly which data would be most relevant and useful—as California did through their ICA proceedings in 2016-17. Regulators must then make this data publicly available on a level-playing field basis to support more informed DER investment decisions. As in the case of California, providers can be mandated to fit smart grid technologies, for example smart inverters, to support grid management.

Next, regulators should look for ways to make regulatory improvements based on the decisions taken by DER providers newly armed with timely, technical data. Lessons can be learned from how Costa Rica is developing bespoke interconnection fees to incentivize DER providers to interconnect in underserved regions of the network. Providers looking to maximize project returns may opt for acquiring land and developing plants closest to the cheapest interconnection points.

Other applications for data-driven regulation might include net metering or energy wheeling. Under both frameworks, DERs are invited to play a more formal role in the electricity network by supplying surplus electricity from self-production back into the network. Net-metering credits and benefits can, for example, be reflective of grid capacity constraints to adequately incentivize providers to focus on these parts of the electricity network. Wheeling projects can similarly provide differentiated credits to customers using wheeled distributed energy based on time of use.

These kinds of pricing signals can efficiently be used to encourage DER grid injection based on when it is most needed (based on peak consumption) and where intermittency challenges must be most closely managed. Energy sector leaders would be using data-driven collaboration and transparency to allow for more flexible market management. They would be positioning the market to fully reap DER benefits and establish the foundation for market management.

Stage 3

Early Market Management

Definition of this stage

In Stage 2 ("Directed Benefits") the State provides data-driven price signals and incentives for DER integration. These incentive-based controls are also used to manage the risks of overloading the grid with intermittent solar and wind power. While these policy levers are supporting more effective, and therefore profitable, DER deployment, they are not expressly aimed at improving the commercial viability of DER projects. To be assured of cost recovery, and indeed profit, providers in Stage 2 still need to diligently innovate and compete for the best customers.

This changes in Stage 3 which we term "Early Market Management." As NREL states in their paper which we've quoted previously, at this stage of market creation, policies are introduced which allow customers to access a market. The policies do not make attempts yet to monetize the non-economic benefits of DERs. Renewable energy penetration has increased, as has private sector participation in generation, distribution, and transmission—activities that previously were likely reserved for national utilities. For the first time, DERs are now fully-fledged participants of increasingly competitive energy markets.

No African country has yet transitioned its wholesale electricity supply to a competitive market in which energy is bought and traded before being sold to end-users. There are, however, examples of private generators being permitted to participate in energy trading through access to regional power pools.

The case studies which follow are a window to a future transformation.

Case Studies
- for Stage 3

New federal rules for DERs in the United States – FERC 2022

Our previous post looked at California to impart lessons on data-driven and collaborative approach to decentralized regulatory development. In Stage 3, Market Management, it is instead *federal* regulation that caught our attention for its limited, but still relevant, applicability to the African context. FERC 2022 is new federal regulation specifically focused on supporting DERs to participate in electricity markets run by the country's regional grid operators. Order 2222 allows aggregators to bundle DERs to satisfy minimum size and performance requirements. Under the rules, tariffs must be revised by regional grid operators to establish DERs as a market participant, which allows aggregators to register them under one or more participation models. It is this DER aggregation policy lever which is also being trialed on African soil.

Namibia and the SAPP:

The South African Power Pool SAPP is one of several regional power pools on the continent, and it has facilitated trading energy across borders since 2009. SAPP has helped participating countries to expand their access to power and improve grid stability. As our colleagues at the CrossBoundary Group article outlined in a **recent article** on PPA bankability, by allowing energy trading across the interconnected regional grid the SAPP has effectively moved participating countries' electricity systems towards market-based energy pricing and trading. SAPP also helps to mitigate utility concerns related to intermittent renewable power given that renewable power can be exported to consumers across borders. Historically, most of the energy trading on the SAPP has been **between government utilities** or through the involvement of 'trader' intermediaries like Africa GreenCo.

Namibia is one of the Southern African markets that has pushed forward to take fuller advantage of the SAPP's benefits. In 2019 the Government published Modified-Single Buyer (MSB) rules which formally transitioned a centralized power system to a **hybrid decentralized model** in which multiple actors generate and supply electricity. IPPs including DER providers can now sell energy to retail customers in Namibia. They can also, more excitingly and appropriate for a Stage 3 case study, trade energy into the SAPP.

Building on this framework in August 2023 Namibia's Electricity Control Board (ECB), NamPower and the Southern African Power Pool (SAPP) issued an **instructive guide** to encourage IPPs trade directly to the SAPP. The guide describes holistically and in detail the requirements for IPPs to become an eligible seller (ES) within the restructured Nambian market, and to thereafter export energy into other SAPP markets.

The work of Namibia's power sector leaders helps to introduce the benefits of DERs through exploration of early market management through the regional power pool.

Recommendation for policymakers and regulators

Transitioning energy markets to competitive wholesale markets is a big step. Wholesale electricity markets are best defined as a platform by which electricity is traded (bought and sold) before being delivered to end customers (including industrial customers). It relies on dispatching power in a flexible manner to meet shifts in energy demand.

While no fully-fledged wholesale electricity market yet exists on the continent, there are other Global South examples that African energy sector leaders can look to for inspiration, such as India and Chile.

The World Bank outlined a core set of principles to advance vertically-integrated, uncompetitive wholesale generation towards competitive wholesale markets. They include demand-side participation, providing open access, and ensuring supply adequacy. Of note, CrossBoundary Energy's experience suggests that these guidelines could be enhanced through greater consideration of DERs as supplemental resources.

While most African countries may not yet be positioned to undertake this extensive sector restructuring, regional power pools are providing the chance to explore the benefits—and complexities—of energy trading and market management mechanisms. Our case study on the SAPP and Namibia's transitioning sector is one such example. Through engaging with energy trading in regional power pools like the SAPP, national utilities and regulators are gaining important insights that will help them prepare for a transition to competitive wholesale markets. Participation in regional markets can also allow electricity customers to realize similar benefits from DERs as wholesale electricity markets, including competitive price signals and the sharing of reserve margins between countries. As is the case in Namibia, regional pools can encourage modification of the traditional single-buyer model to make way for increased integration of DERs.

DER aggregation is another policy lever which allows for more effective DER participation in wholesale electricity markets. Despite the continued prevalence of the single-buyer model in Africa, this policy building block is also being tentatively trialled on African soil. In the SAPP, energy traders are supporting smaller-scale DERs to access power pools by purchasing power from multiple IPPs and selling that power to a diversified portfolio of purchasers through supply agreements. In turn, the commercial viability of individual DER projects is enhanced. Wholesale markets may not yet exist, but the same principles of DER aggregation are being applied. Regional power markets provide an opportunity to maximize the advantages of DERs for your network, even if a full transition to a competitive wholesale market is not feasible in the short-term.

Conclusion

Accelerated deployment of renewable DERs offers African policymakers, utilities, and businesses the opportunity to realize numerous benefits over and above what the centralized integrated utility alone can provide. And yet, this transition also poses considerable risks to each of these parties if it is not undertaken thoughtfully, harnessing the relevant experiences of similar countries.

In this White Paper we at CrossBoundary Energy have leveraged our experience deploying DERs in Africa to propose a stage-gate framework for DER policy evolution, drawn largely from what African regulators are already doing to integrate these new energy resources. We noted the initial responsibility of the State to establish dedicated DER policies in Stage 0, then amending DER licensing procedures in **Stage 1**, and finally to using network data to inform the most effective, stable, and agile configuration of DER assets in **Stage 2**. We see these reforms as essential foundations to prepare African energy sector leaders for **Stage 3**: exploring future market mechanisms with DERs in mind.

By sharing our opinions on when certain DER policy building blocks should be selected at different stages of electricity market evolution, we hope to encourage more practical policy debate about how to tailor this framework to national contexts. We hope to see a doing away with abstract arguments which paralyze the most technocratic and competent energy regulators. In our view, maximizing the benefits while controlling the risks of DER integration rests on using the right tool for the problem, and doing so at the right time.

We envision a future on the continent where new, emerging market structures will allow investors and developers of DERs to be compensated for their contribution to robust national energy systems, guided by signals from the dynamic systems regulators have established to protect the public interest. A future in which a level playing field will have been built for more bankable projects, the risks associated with DER integration will be well-known, and utilities will have established data-based tools to ensure they are mitigated. The grid of the future will be defined by cleaner, more affordable, and more reliable energy for industry.

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CrossBoundary Energy

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Constructing Africa's Green Economy Requires New Building Blocks

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Cautious Co-existence CrossBoundary Energy is a leading developer, owner, and operator of distributed renewable energy solutions for businesses, providing cheaper and cleaner energy through power purchase and lease agreements. CrossBoundary Energy is currently delivering a portfolio of over $420 million of solar renewable energy assets for clients including Unilever, Diageo, Rio Tinto, Heineken, and AB InBev, and was recognized by Africa Solar Industry Association as "Solar Company of the Year" in 2022. CrossBoundary Energy is a member company of the CrossBoundary Group, a mission-driven investment firm founded in 2011and committed to unlocking the power of capital for sustainable growth and strong returns in underserved markets. Find out more at **www.crossboundaryenergy.com**.