Renewable Energy in Sub-Saharan Africa

Opportunities & Challenges

ACORE
American Council On Renewable Energy

July 2015

RENEWABLE ENERGY IN SUB-SAHARAN AFRICA: OPPORTUNITIES & CHALLENGES

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ACORE, a 501(c)(3) non-profit membership organization, is dedicated to building a secure and prosperous America with clean, renewable energy. ACORE seeks to advance renewable energy through finance, policy, technology, and market development and is concentrating its member focus in 2015 on National Defense & Security, Power Generation & Infrastructure, Transportation, and International Markets. Additional information is available at www.acore.org.

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EXECUTIVE SUMMARY

Two-thirds of sub-Saharan Africa's population, more than 600 million people, do not have access to electricity. The region will require an investment of roughly $450 billion to achieve universal electricity access in urban areas by 2040.[1] Renewable energy in all its forms – including utility-scale systems, distributed generation, thermal energy, transportation fuels, and off-grid systems – will be an essential piece of this development, but needs sound public policy, strong financial mechanisms, business innovation, and international cooperation to attract investment and develop markets sustainably. The articles in this report, authored by a representative of the U.S. Overseas Private Investment Corporation, a solar thermal developer, a microgrid company, and a law firm, focus on opportunities presented by selected markets and offer insights on advancing project development in the region.

Renewable energy investment in sub-Saharan Africa is already on the rise, with more than $6.8 billion dedicated to utility-scale projects in 2014, a 9.5% increase from 2013.[2] South Africa was one of the best-performing countries in the world for renewables investment in the first quarter of 2015, attracting $3.1 billion.[3] Renewable energy auctions, feed-in tariffs, mandates, and other government support from multiple sub-Saharan African countries are expected to keep investor appetites healthy.

By the end of 2015, 1.7 gigawatts (GW) of wind, 1.3 GW of solar, and 0.5 GW of geothermal, totaling 3.5 GW, will be operational. According to current projections from Bloomberg New Energy Finance, cumulative capacity in these sectors will increase 300% by the end of 2020, to nearly 14 GW.[4] However, this development will only exploit a fraction of the region's diverse resource potential. There remains 400 GW of undeveloped hydropower potential, 17 GW of geothermal potential, as well as immense untapped solar, wind, biomass, and ocean energy resources.[5]

A number of political and financial variables are shifting to take greater advantage of this potential. While hurdles remain, costs for renewable energy are decreasing, and transmission and distribution upgrades are underway. Recent cost declines in solar photovoltaic and storage technologies are making microgrids a cost-effective energy access solution in rural, off-grid areas, including much of sub-Saharan Africa. Pay-as-you-go models, mobile money,

[1] International Energy Agency (IEA), *Africa Energy Outlook*, 2014, http://www.iea.org/publications/freepublications/publication/weo2014_africaenergyoutlook.pdf

[2] Bloomberg New Energy Finance (BNEF), *H1 2015 Sub-Saharan Africa Market Outlook*, February 19, 2015

[3] BNEF, "South Africa Stands Out in Subdued Q1 for Clean Energy Investment", April 10, 2015, http://about.bnef.com/press-releases/south-africa-stands-subdued-q1-clean-energy-investment

[4] BNEF, *H1 2015 Sub-Saharan Africa Market Outlook*, February 19, 2015

[5] World Bank Group, *The Power of the Mine: A Transformative Opportunity for Sub-Saharan Africa*, 2015, https://openknowledge.worldbank.org/bitstream/handle/10986/21402/9781464802928.pdf

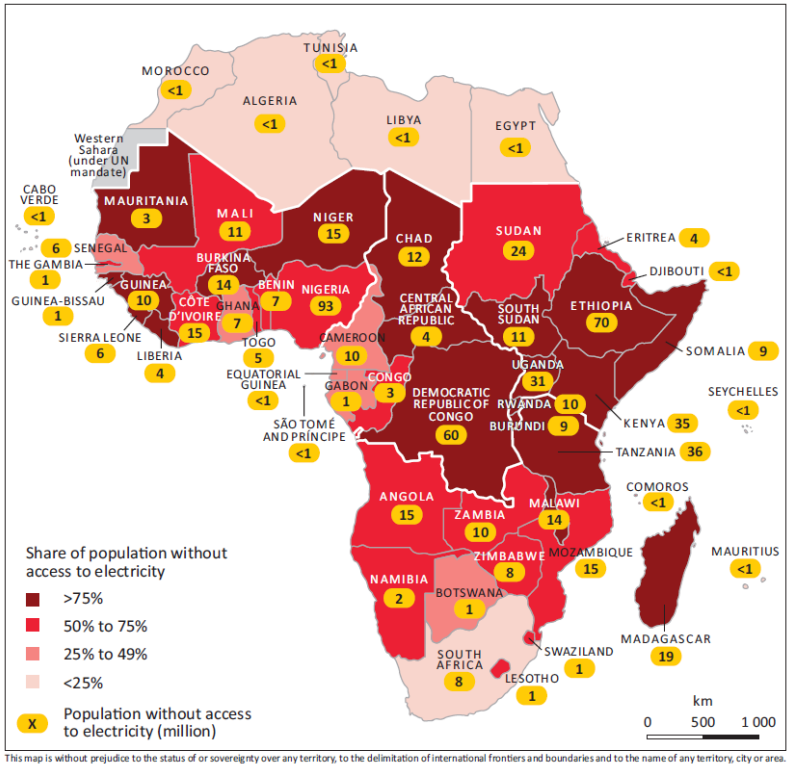

Image: Number and share of people without access to electricity by country, 2012 (International Energy Agency)

and other innovative mechanisms have emerged to help finance such projects in cash-strapped, remote areas. Nevertheless, country progress is uneven, and some areas require major reform before projects can become viable.

International political actors are increasing renewables investment in the region. In 2013, President Barack Obama announced Power Africa, a USAID initiative to increase the number of people with access to electricity in sub-Saharan Africa. Presently, Power Africa has leveraged over $20 billion from the private sector for new on- and off-grid projects. It has established strategic partnerships with the World Bank, the African Development Bank, and the Government of Sweden, which in total have committed an additional $9 billion to renewable energy projects in the region through the initiative.[6] Additionally, China, long involved in Africa's energy industry, will continue to invest billions of dollars in the renewables sector. Financial instruments like green bonds through organizations such as the World Bank minimize investor risk and support private-sector investment in renewable energy. The World Bank has issued an estimated $8 billion in green bonds in the region through over 90 transactions in 18 currencies.[7]

As the articles in this report demonstrate, public-private partnerships such as these, as well as domestic policy reforms and creative policy and financing structures, are helping spur increased international investment and project development in the region. Strong regulatory reform and transparency remain critical for foreign investment, but sovereign debt and other alternative financing mechanisms can help to facilitate project development. Concessions can

[6] The White House, "Factsheet: Power Africa", July 25, 2015, https://www.whitehouse.gov/the-press-office/2015/07/25/fact-sheet-power-africa

[7] United Nations Africa Renewal, "New bond issue set to help Africa go 'green'", August 2015, http://www.un.org/africarenewal/magazine/august-2015/new-bond-issue-set-help-africa-go-%E2%80%98green%E2%80%99

serve as another important tool for private-sector companies, increasing a provider's ability to attract financing and meet eligibility requirements for government-sponsored incentives.

It is essential to understand sub-Saharan Africa's energy markets and their unique business models and technological innovations suited to the region. New technologies and innovative business models are enhancing the prospects for off- and on-grid development.

The views and opinions expressed in this report are those of the authors and do not necessarily reflect the views of ACORE.

FINANCING FOR RENEWABLE ENERGY SOLUTIONS IN AFRICA'S OFF-GRID MARKET

Lynn Tabernacki, Overseas Private Investment Corporation

Access to electricity provides a fundamental basis for economic growth. Yet two-thirds of the sub-Saharan African population (~600 million people) may never engage in the seemingly simple task of turning on a light. Without the ability to access sufficient electricity in homes or for trade and commerce, the region remains at a disadvantage in keeping up with the developed world.

Many entities engaged in international development and impact investing, along with donor foundations and private-sector investors (familiar with the risk-reward algorithm), are pivoting their attention to the region. Large-scale power projects designed to meet increasing energy demands are gradually being awarded and built in a number of countries. For smaller off-grid solutions, one conclusion is clear: the competitive costs of renewable energy solutions provide solid alternatives for addressing energy access needs that extend beyond the grid.

The primary driver for any successful project, large or small, still remains its financing. When attempting to finance off-grid projects, the primary challenge is identifying a straightforward, expeditious, flexible and cost-effective model for financing their development.

Financing Off-Grid Projects

Expanding the off-grid energy market provides a significant opportunity for rapid and pervasive energy development in the region. There are two types of off-grid projects prevalent in sub-Saharan Africa: (a) village-level mini- or micro-grids, and (b) market-based consumer solutions (*e.g.* solar home kits). In each case, raising equity is a challenge until the business model has been proven. Potential equity investors want to ascertain that the management is capable of a measured approach for growth and, once confirmed, that the model can be replicated easily across markets with a steep trajectory.

Once equity is in place, a company will focus on debt for an appropriate amount of leverage. For years, lenders have approached small village-level projects as typical infrastructure financings. Projects are viewed through a conservative lens requiring traditional underwriting as well as collateral and security structures, which include liens on assets, assignment of agreements, waterfall accounts, cash reserves, etc. However, small village-level projects are not necessarily conducive to this approach. Analyzing, approving, and negotiating such detailed structures typically requires months. In addition, the legal and engineering review costs can be disproportionate for projects of this size, because fees are charged by time spent rather than the dollar value of the transaction.

As implementation times and costs increase, investors' internal rates of return begin to erode. By requiring rigid infrastructure-type financing structures, lenders might effectively reduce both the financial ability and the motivation of investors to undertake additional projects. This is unfortunate because these small systems have the highest developmental impacts. Village-scale systems can be put in place relatively quickly and can connect a broad base of customers that otherwise would not have energy access.

Some lenders have begun using a new template. Village-level financings now focus on multiple villages in a pipeline, rather than on individual projects – more attractive to equity investors than one-off projects. Similar projects can be grouped together into one portfolio financing. Common characteristics of projects within a portfolio might include similar capacities of each installation, the same investors, a similar revenue capture method, a standardized approach to technology and design, and the same engineering, procurement and construction (EPC) contractors and operations and maintenance (O&M) providers. These commonalities allow a lender to evaluate all projects under the same light, at the same time, as effectively one underwriting.

Once a lender is comfortable with these commonalities, the loan agreement stipulates requirements to be followed across all village projects. For example, the company will be obligated to utilize a defined billing and collection methodology approved by the lender; villages must fit within criteria relating to economic activity, population size, location, and other distinct factors; and only certain technologies or equipment are pre-approved for installation. By defining these requirements upfront, investors have a roadmap for future business growth. The costs incurred in the initial assessment can now be spread over multiple projects and, if successful, additional tranches can be added to the initial financing fairly easily. Unfortunately, lenders can only develop financing for multiple villages when there is equity available *pro rata*. This is the common predicament for portfolio sizing.

Lenders typically seek the strongest collateral and security packages available. However, in a portfolio approach, the strength of the credit derives from the diversity of the portfolio itself and less so from the asset value of the individual plants. For example, a loan could be made to a project company to support the installation of renewable energy generation systems in ten villages. If one village has difficulty making its payments, the lender would be able to rely on cash flows from the remaining nine villages without a default occurring under the loan agreement. The diversity of the portfolio provides robustness to the cash flows and enables the lender to avoid a time-consuming loan workout for a small village-level loan.

On the other hand, if the diversity is insufficient and cash flows from the other villages are unable to fully provide for debt repayment, the project company would be in default of its loan. Under a traditional project finance structure, the lender would have obtained liens on the assets placed in each village and would have a right to foreclose on the property. In reality, the lender would unlikely foreclose on the assets of the nine paying villages, because

Image: Solar panel in Salmonsdam Nature Reserve, Western Cape, South Africa

the long-term cash flow streams from those customers remain reliable and likely to exceed the generating assets' values.

Given this scenario, the portfolio approach dictates that the lender should forego traditional equipment liens, but tightly secure the most liquid assets. This should include assignment of bank accounts to which all customer payments are directed or deposited, a debt service reserve account, and step-in rights or a pledge of shares in the project company if local law enables the lender to act quickly. Credit committees may object to the notion of foregoing collateral, but the costs of obtaining the physical assets outweigh the actual need.

In summary, portfolio financing can be established for small plants to be installed in the short term by defining key parameters and narrowing collateral and security requirements to the most likely remedies to be used. In this way, village-level renewable energy projects can happen more rapidly, have a broader reach, and not significantly increase risks to the lenders. These factors are critical in the African context where the energy need is great and the opportunities for main grid connection are low. The structure is also more attractive for both equity investors and impact investors looking to deploy larger sums in the region. With everyone's interests aligned, broad-scale change is possible.

Market-Based Consumer Solutions

A number of companies in Africa provide market-based solutions that allow residential and commercial customers flexibility in their energy usage. Some companies sell solar home kits, while others provide pay-as-you-go services for utilizing individual solar-based units. Most of these companies are in early-stage growth; some are well-capitalized, and some are working with small budgets. A company's success can be determined by its ability to quickly achieve measurable market penetration and consumer adoption. Therefore, it is essential for the financing structure to flexibly, cost-effectively, and efficiently adapt to the requirements of steep and rapid growth.

In many cases, lenders have treated businesses based on solar home kits as power projects requiring a level of underwriting as well as collateral and security akin to an asset securitization. For example, for service-based systems, lenders have traditionally taken a lien on the solar kits, along with an assignment of the customer agreements and receivables. More specifically, the lender's repayment streams and collateral package are tied to an identified set of customer contracts.

However, these businesses have less in common with power providers than they do with retailers that have customers who pay over time. As such, a corporate loan might be a better fit, even if the company is in its early stages of development. The debt should not be sized or tied to a particular set of assets. Rather, the debt should be set at an acceptable proportion to equity, taking into account a conservative growth scenario. Disbursements would occur as certain milestones are achieved. But rather than tie repayment to a pool of receivables, the lender would have access to all cash flows of the company. As the company's growth calls for additional debt, the lender might provide another tranche, or another lender could be added *pari passu*, also without a lien on specific assets.

The collateral and security structure of this form of corporate loan also would be streamlined. Once again, there would be assignment of customer payment accounts, a debt service reserve, step-in rights or a pledge of shares, and assignment of fundamental contracts, such as the billing and collection agreement (usually with the local mobile telecoms provider). These remedies are reasonable in that a lender is highly unlikely to seek to recover all of the home kits, and would not step into thousands of customer contracts.

If the company is relatively successful, but unable to immediately meet debt service, customer payments would flow into the bank accounts. It is better to restructure the amortization schedule to capture these flows than to recover any assets or disrupt the payments. If the company fails, it is possible that the technology was not successful or did not have the longevity expected. In that case, the lender would not make the effort to recover the assets and should capture any remaining payments made into the account.

OPIC, and others, have provided early-stage funding and technical assistance to these types of service providers in Africa, such as Off-Grid Electric, Nova Lumos, M-Kopa, dLight, et al., with the intention of serving consumer needs at least until more permanent, grid-type solutions are available. However, when it is time for longer term financing of entities such as these, a corporate financing structure will provide greater flexibility as businesses gain traction.

Conclusion

Both portfolio financings and corporate financings are unconventional means for lending to renewable energy projects. Not all lenders embrace financings of this type. Usually, development banks take the lead in risk mitigation tools and unique structures. Novel lending models demonstrate to private-sector lenders where lessons can be learned and improvements made. It is important that new financing structures are crafted to match new business models as they are pioneered, and it is even more critical when the financing can catalyze projects with an opportunity for exponential growth.

Investors should seek lenders willing to consider transactions outside a traditional project finance structure. The flexibility and replicability will align stakeholder interests and deliver meaningful results for sub-Saharan energy access and economic advancement.

About the Author

Lynn Tabernacki is the Managing Director of the Overseas Private Investment Corporation's (OPIC) Renewable Energy Program. With OPIC since 1995, her efforts are focused on supporting investments in renewable and clean energy, energy efficiency, and clean tech leasing. Ms. Tabernacki has led OPIC's Renewable Energy program from 2007 and has seen OPIC's support for renewable and clean energy projects grow to over $1 billion in each of the last four years, representing one-third of OPIC's annual commitments.

SOUTH AFRICA: LEADING THE WAY FORWARD FOR CSP

Joseph Desmond, BrightSource Energy

China, sub-Saharan Africa, India, and other emerging markets are expected to be the primary contributors to both greenhouse gas emissions and energy demand growth in the coming decades. The good news is there is growing policy support for renewables in these markets because clean tech is viewed as essential to meeting both economic and environmental goals.

As the penetration of renewable energy increases globally, policymakers and utilities have shown growing interest in technologies that can ensure long-term reliability without increasing emissions. Regulators, utilities, and grid operators are increasingly applying a "net system cost" methodology when considering future energy portfolios and procurement decisions.[8] This approach considers factors such as system integration costs and reliability impacts under different scenarios.

Concentrating Solar Power (CSP) with thermal energy storage is one example of a flexible resource that can help address the supply variability introduced by rapidly expanding wind and solar photovoltaic energy production. Recent studies show that the technology can play an important role in achieving global clean energy and climate goals by providing dispatchable power when it is needed most, improving reliability and reducing costs.[9]

The investment community is taking note of the various factors that are moving in favor of renewables. According to the United Nations Environment Programme's (UNEP) *Global Trends in Renewable Energy Investment 2015*, "Renewables are being seen increasingly as a stable – even relatively low-risk – investment by institutional funds. This is evident partly in the rising commitment by institutions to renewable power projects, and partly in their backing for green bonds, which hit a record $39 billion of issuance in 2014."[10]

South Africa: Expanding Renewable Energy Development

South Africa is a particularly exciting area for CSP and other renewables. The country is implementing the largest renewable energy program on the African continent, and the South African government is committed to diversifying its energy mix, which until now has been based predominantly on coal. In April 2015, Bloomberg reported South Africa was a bright

[8] Concentrating Solar Power Alliance, *The Economic and Reliability Benefits of CSP and Thermal Energy Storage*, 2014, http://www.csp-alliance.org/updated-cspa-report-september-2014

[9] *Ibid.*

[10] UNEP and BNEF, *Global Trends in Renewable Energy Investment 2015*, March 2015, http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2015

spot for clean energy investment in Q1 2015, attracting approximately $3 billion in renewable energy investment.[11]

To its credit, South Africa has relied on best practices learned in other renewable energy markets to guide its procurement program design and implementation.[12] This past December, South Africa announced plans to almost double the amount of power it intends to draw from renewable sources based on the success of the current program, which reflects these key attributes:

- Adopt a business-friendly approach
- Take a long-term approach
- Take advantage of external sources of funding
- Establish and continue to make a case for renewable energy

Additionally, South Africa gives considerable weight to non-price factors, such as job creation, local content, ownership, management control, preferential procurement, enterprise development, and socio-economic development. Fortunately, the components needed to construct CSP projects easily lend themselves to high levels of localization.

South Africa: Improving the Project Development Process

The development process for utility-scale renewable energy power projects is well understood. Developing a CSP plant or other large renewable energy project is similar to developing a traditional thermal power plant.

A site is the first requirement; investors must be assured of access to the site for construction and operation of the facility for the term of the contract. This is known as site control.

The second requirement is that the renewable resource under development, whether sun, wind, biomass or geothermal, needs to be characterized and understood at a level of detail and confidence appropriate to the project's stage of development. Resource data is an important consideration and can impact the viability and marketability of a project, and there are a number of quality resources available for the South African market.

The solar industry needs access to a single document addressing the key aspects of solar resource characterization. For example, the U.S. National Renewable Energy Laboratory

[11] BNEF, "South Africa Stands Out in Subdued Q1 for Clean Energy Investment", April 10, 2015, http://about.bnef.com/press-releases/south-africa-stands-subdued-q1-clean-energy-investment

[12] World Bank Group, *South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons Learned*, 2014, http://www.ppiaf.org/sites/ppiaf.org/files/publication/South-Africa-REIPP-Report_final_web.pdf

Image: BrightSource Ivanpah solar CSP project in California's Mojave Desert

(NREL) recently released an updated handbook on the best practices for collection and use of solar resource data, featuring new contributions from an international group of experts.[13]

Southern Africa is investing in better information to help developers, evidenced by the Southern African Universities Radiometric Network's (SAURAN) map of solar MET stations and associated data.[14] SAURAN aims to make high-resolution, ground-based solar radiometric data available from stations located across the Southern African region, including South Africa, Namibia, Botswana and Reunion Island.

The third requirement is that the off-take agreement, such as a feed-in tariff (FIT), power purchase agreement (PPA), or other agreement that includes the terms of sale of energy between the project owner and the buyer, and any other output of the project (such as renewable or carbon credits), generate funds to pay for the project. The offtake includes the necessary transmission access and related agreements needed to deliver the power to market.

These three elements taken together – site, resource and offtake – create value that promotes further investment. Securing these three elements by contract is a significant milestone for every developer. South Africa is now playing a key role globally in discussions around effective policies to increase renewable energy investment. It transitioned from a FIT approach to a competitive bid process with great success.

The remaining elements – permit, technology, qualified team, and development capital – round out the list of project variables that attract investment, and with every piece

[13] NREL, *Best Practices Handbook for the Collection and Use of Solar Resource Data for Solar Energy Applications*, February 2015, http://www.nrel.gov/docs/fy15osti/63112.pdf

[14] SAURAN, "Solar Radiometric Data for the Public", 2015, http://www.sauran.net

documented, the project will attract the financial resources necessary for construction, commissioning, and initial operations.

Raising and closing financing is the final element in project development, but it is important to note that capital requirements do not begin at construction; they are required throughout the multi-year development process. To successfully attract private financing, a project must be fully defined with risks and unknowns mitigated and allocated to appropriate parties.

About 60% of the financing provided for South Africa's Renewable Energy Independent Power Producer Procurement Program projects has been funded by South African banks, reflecting their positive view of CSP bankability and their growing comfort with the technology. To further support CSP development, South Africa is increasing commitment from the government and its financing institutions, while at the same time working to address grid connectivity and insufficient capacity, especially in the Northern Cape Province where many CSP projects will be located.[15]

Conclusion: South Africa's CSP Growth Potential

CSP with thermal energy storage has potential applications in many countries and regions of the world that have different market structures and regulatory regimes. These institutional differences must be considered when valuing CSP with thermal energy storage in particular regions.

In countries with transparent wholesale markets, it is easier to value a plant's attributes, but historical prices do not necessarily help in forecasting future system considerations. In regions without such markets, such as South Africa, resource planning methods used by utilities can similarly use simulations to estimate the value (net system cost) of alternative renewable resources. While there are many factors that contribute to the overall cost of operation, generally speaking, those areas with the highest amount of direct sunlight (Direct Normal Insolation, or DNI) will produce the lowest levelized cost of energy.

BrightSource's confidence in the South African market for our technology and future growth opportunities for CSP is based on partnering with strong South African companies; continued innovation and cost reduction of solar thermal technologies; and the growing global recognition of the value of CSP with thermal energy storage. Equally important, BrightSource is confident in South Africa's long-term commitment to promote a low-carbon economy that expands the opportunities for clean energy technology, environmental protection, and job creation.

[15] CSP Today, *CSP Today Markets Report 2015 – South Africa*, 2015, http://www.csptoday.com/research/CSP-markets-series-index.php

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BrightSource Energy, Inc. designs, develops, and deploys concentrating solar thermal technology to produce high-value steam for electric power, petroleum, and industrial-process markets worldwide. BrightSource combines breakthrough technology with world-class solar thermal plant design capabilities to generate clean energy reliably and responsibly. BrightSource's solar thermal system is designed to minimize impact to the environment and help customers meet their clean energy goals. Headquartered in Oakland, California, BrightSource Energy is a privately held company with operations in the United States, China, Europe, Israel, and South Africa. For more information on BrightSource Energy, please visit www.brightsourceenergy.com.

EAST AFRICA'S GEOTHERMAL RESOURCES: DEVELOPMENT THROUGH REGIONAL INTEGRATION

Earl Gast, with Research Support from Mary Yang, Covington & Burling LLP

With 15 to 20 gigawatts of potential power beneath the earth's surface[16] and the technology available to harness this power source through commercial means, geothermal power development is positioned to take off in East Africa. Unfortunately, a lack of awareness and understanding of geothermal power, coupled with outdated laws and weak governmental institutions, are holding back the development of this resource in the region. This situation could be vastly improved, however, through greater regional integration in the form of a regional Center of Excellence that would focus on research, policy development, and project deployment.

Africa as a whole is starved of power. The African Development Bank estimates that Africa loses at least two percentage points of gross domestic product annually because of power constraints.[17] More importantly, some 600 million Africans lack access to reliable power.[18]

New fossil fuel development will play a large role in increasing electricity access in East Africa. Significant natural gas discoveries off the coasts of Mozambique and Tanzania will be a game-changer for regional electricity generation and expand these countries' economies. Additionally, countries with significant coal reserves, such as Mozambique, are scaling up regional coal-fired power production.

In contrast, while clean power solutions present tremendous opportunities to generate more electricity and reduce reliance on fossil fuels, East African countries are adopting clean technologies less successfully. Renewable, environmentally friendly power, including hydro, solar, wind, and geothermal, can be delivered at scale and with affordable prices. In particular, geothermal can serve as baseload power, has minimal effects on the environment (when systems are properly designed), and is plentiful and affordable in East Africa.

Several factors are limiting the potential of geothermal energy as a power source. Chief among these factors is a lack of awareness and understanding, which weakens public support. As an example, an ambassador posted to an East African country prevented U.S. assistance for geothermal from going forward until his energy team could prove the earth's core temperature would not cool as a result. Clearly, significant education and building of public support is needed.

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[16] Geothermal Energy Association, "U.S.-East Africa Geothermal Partnership," accessed July 22, 2015, http://www.geo-energy.org/EastAfrica/EAGP.aspx.

[17] Comments made by African Development Bank President Kaberuka at Annual Meeting in Abidjan, Cote d'Ivoire (May 2015).

[18] *Ibid.*

Another factor is the political and regulatory hurdles put in place in individual countries. Each country in East Africa is taking its own approach in creating the legal and regulatory environments governing the use of their geothermal resources. Kenya was once a recognized leader in this field but has stalled, requiring new policy commitment. Rwanda, which has an investor-friendly business environment and a power gap to fill, aggressively pursued geothermal development but acted on drilling decisions before the necessary scientific data was available. This proved to be a costly mistake, leading the Rwandan government to spend upwards of $30 million for non-productive wells.[19] Tanzania identified its power priorities in its *Big Results Now!* plan, which excludes geothermal and lays out specific priorities by project and technology.[20] Ethiopia aims to become a major exporter of power for geopolitical and economic reasons. Its model has been to develop large, generally clean, power projects, including geothermal, but its laws and regulatory framework to attract private investment have not kept pace. For example, the government's regulatory framework for mining also guides its actions in geothermal power production. Its experience in negotiating the 500 megawatt (MW) Corbetti geothermal project, however, is instructing the drafting of a new law in this sector.[21]

Can East Africa Learn from the Kenyan Experience?

Once an early adopter of geothermal energy, Kenya is now far from cutting edge. Kenya's power generation company, KenGen, formed a group of experts who developed and executed a focused vision for geothermal development. Power projects came on line, which generated more interest in geothermal from the private sector. Kenya then made a strategic choice to consolidate KenGen's expertise into a newly created government-owned company, the Geothermal Development Company (GDC), established in 2008. Yet KenGen still remains involved in geothermal development – recently commissioning the final installment of a 280 MW geothermal plant at its Olkaria site– complicating the landscape.

GDC was founded to allow the government to absorb development risk and accelerate development. Private capital would not need to be expended because the government would conduct geo-physical studies, initiate drilling of test wells, build necessary infrastructure within the geothermal sites, and, only when there was evidence of commercial viability, sell the site to a project developer.

However, this approach does not take advantage of the ingenuity, capability, speed, and cost-effectiveness of the private sector. Instead of relying on proven geothermal developers, GDC's approach was highly reliant on timely government action, funding, execution, and technical expertise. Also, GDC focused too exclusively on technology, dedicating more government

[19] Telephone Interview with Gordon Bloomquist, Chair, International Geothermal Association Finance Committee of the 2015 World Geothermal Congress (Jun. 25, 2015)

[20] Author's Conversation with Omari Issa, CEO of the Tanzanian President's Delivery Bureau (Spring 2014).

[21] Telephone Interview with Nebiyou Girma, USAID Senior Transaction Advisor, Power Africa Initiative (Jun. 20, 2015).

Image: Olkaria II geothermal power plant in Kenya

funding to drilling rigs and rig training than to feasibility studies that may have led to project tenders. Standard industry practice is to hire drilling rigs and experts, rather than developing that expensive capacity within government. Time also has been a variable affecting GDC's success. Rig time is costly, and managing drilling pace is critical to containing costs and staying on budget. The industry standard is 70 days per well. The GDC, however, has averaged 90 days.

The Uhuru Kenyatta government came into office in 2013 with big plans for increasing power generation, adding more than 500 MW to the grid in the last 24 months, with about half of this capacity from geothermal resources. Today, geothermal accounts for approximately 25% of capacity, but a great majority of that amount is through KenGen, not GDC. When it became evident that GDC would not meet its targets, the government elected to tender the "3X35 Program"[22] as a means of demonstrating some progress in the short term. Today, GDC is under intense scrutiny and has faced questions of corruption and mismanagement.

A complete overhaul, not only of the organization, but of its mandate, is urgently needed. Less government involvement on the development side has proven to be a far more effective model. In both Turkey and Indonesia, for example, once exploratory wells have been drilled, the governments have issued tenders for full exploitation and development of the concessions. Development costs have been lower and the time of bringing power to the grid has been reduced.[23]

[22] In August 2013, KenGen issued a tender for three separate projects at 35 MW each at the Olkaria site.

[23] Yang conversation with Mike Long, Head of GEA's International Committee (May 28, 2015).

At a time when African governments are urged to seek common best-practice approaches to energy and harmonize their rules, most in East Africa seem to be acting independently on geothermal production and are unaware of how other governments and institutions are organized and operating. Donors talk of working regionally but act bilaterally. And the African Union (AU), which houses the Geothermal Risk Mitigation Facility, cannot take on policy coordination and program implementation for a resource that touches only a handful of the AU's 54 member states.

Is a Regional Center of Excellence the Answer?

Experts, governments, donors, and industry leaders need to be able to organize regionally, for jointly staffed teams to conduct geophysical surveys, specialists from the region to study common core subjects together, and policymakers to discuss measures that prove attractive to investment. Some experts have proposed the idea of a regional geothermal Center of Excellence. The experience of the international development community supports the idea of this type of center. Creating a well-designed, empowered, and funded institution that primarily focuses on research to help shape further policy implementation and project deployment is what is needed to accelerate geothermal energy production in East Africa.

A Center of Excellence would help mobilize a collective awareness of the benefits of geothermal power; coordinate donors' approaches, dialogue, and instruments at one facility; and serve as a repository for geophysical data sets. Moreover, it could become a resource center for the private sector, linking investors to projects, geophysical data, government agencies, donor programs and tools, and financial institutions.

Effective models for such a center exist. The Andean Geothermal Center of Excellence (CEGA), for example, concentrates its efforts mostly on scientific research, geophysical studies of geothermal fields in the Andes, and education. This Chile-based institution is regional in scope and has formed partnerships with other research institutions, notably the Lawrence Berkeley National Laboratory in the United States. Such an approach is urgently needed in the Rift Valley, where international partnerships are now limited.

If a regional Center of Excellence is acknowledged as a critical factor for success –measured as more geothermal power coming on line more quickly – the question remains where it should be housed. Today, regional integration in Africa is happening in multiple sectors, with the East African Community (EAC)[24] at the vanguard. The EAC should host a regional Center of Excellence for geothermal and invite outside participation from both Djibouti and Ethiopia. President Obama placed great confidence in the EAC by announcing in 2013 that *Trade*

[24] The EAC is a Regional Economic Community (REC) that consist of Burundi, Kenya, Rwanda, Tanzania, and Uganda (http://www.eac.int/).

Africa[25] would support the EAC's and constituent countries' aspirations of becoming one market. In spite of having a nascent power pool, power trading and the use of common power standards are gaining hold in East Africa. A Center of Excellence would add credence to the EAC and take advantage of its strong leadership and effectiveness of its institutions. The EAC's mandate emphasizes widening and deepening regional cooperation on policy, research, technology, and skills development. As the African institution entrusted to coordinate the integration of smaller economies into a larger regional economy, the EAC should be called upon to establish a Center of Excellence for the development of East Africa's geothermal resources.

About the Authors

In an increasingly regulated world, Covington & Burling LLP provides corporate, litigation, and regulatory expertise to help clients navigate their most complex business problems, deals, and disputes. Founded in 1919, the firm has more than 800 lawyers in offices in Beijing, Brussels, London, Los Angeles, New York, San Francisco, Seoul, Shanghai, Silicon Valley, and Washington.

Earl Gast is a senior international advisor for Covington's Africa Initiative. Mr. Gast, a non-lawyer, was the Assistant Administrator for Africa at the United States Agency for International Development (USAID) prior to joining the firm. In this role, he oversaw development policy for Africa, contributing to President Obama's Strategy for Africa, and he played a leading role in creating three major presidential development initiatives: *Power Africa*; the *Young African Leaders Initiative*; and *Trade Africa*. He introduced new approaches to financing development, leveraging billions of dollars of private capital toward development initiatives. He led USAID's largest bureau of more than 3,000 employees and oversaw a development portfolio of more than $7 billion in 49 African countries. He started his career at USAID in the Philippines where he helped introduce project finance and private sector investment in the power sector, and in doing so, first got involved in geothermal power.

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[25] *Trade Africa* is a presidential initiative of the Obama Administration that seeks through partnership to promote economic growth through increased trade and regional integration. The EAC was chosen as the first region for this partnership with the U.S. because of its progress toward policy harmonization and integration.

POWERHIVE CASE STUDY: MICROGRID REGULATION FOR ENERGY ACCESS IN EMERGING MARKETS

Christopher Hornor, Powerhive and Marc van Gerven, FirstSolar

An estimated 20% of the world's population—approximately 1.4 billion people—live without access to electricity,[26] stifling economic and human development. As governments, international organizations, and companies across the globe strive for universal electricity access, it is clear that microgrids will play a critical role in achieving this goal.

Recent cost declines in solar photovoltaic (PV) and storage technologies have made microgrids the most cost-effective energy access solution in more than half of the world's off-grid areas, such as sub-Saharan Africa.[27]

As government agencies and multilaterals have come to realize, achieving energy access goals requires an environment where policy encourages private-sector microgrid development. A flexible regulatory environment can assist in enabling energy access. In addition, policymakers must evaluate the ability of a provider to effectively deliver electricity to the end-user while complying with local standards. Conversely, in markets that lack an established regulatory framework governing microgrids, or that exempt microgrids below a certain size from regulation, providers may find themselves in a position where they are able to pioneer and prove their models, using the results to make the case for microgrids.

Powerhive: A Case Study

Powerhive is a microgrid solution provider in emerging markets, with a proprietary technology platform that streamlines microgrid development and customer management. Powerhive's experience in Kenya provides a useful case study for identifying mechanisms the private and public sectors alike can use to incentivize and spur the development of microgrids in emerging markets.

With over two years of field testing, Powerhive's four pilot projects each offer 100% renewable energy to customers who purchase electricity on a pay-as-you-go basis using mobile money applications on their mobile phones.

To test Powerhive's business model and technology, the first pilot project of 1.5 kW was commissioned in August 2012, catering to a small cluster of residential customers in the village of Mokomoni. Customers in Mokomoni use the electricity for indoor and outdoor

[26] International Finance Corporation, "IFC and Infrastructure," April 2015, http://www.ifc.org/wps/wcm/connect/1ba497004f36e5fa9c14de032730e94e/SM2015_IFCIssueBrief_Infrastructure.pdf?MOD=AJPERES

[27] Africa-EU Renewable Energy Cooperation Programme (RECP), "Mini-grid Policy Toolkit: Policy and Business Frameworks for Successful Mini-grid Roll-outs," 2014, http://euei-pdf.org/thematic-studies/mini-grid-policy-toolkit

Microgrids: Powerful Impact

Before accessing electricity, typical residential customers in these villages relied on kerosene for lighting and disposable batteries to power small appliances (*e.g.* radios). They frequently walked miles to central kiosks where they could pay to charge their cell phones. Typical commercial customers relied on diesel generators, which are costly to operate and difficult to maintain. With microgrid access, Powerhive customers have been able to save money while increasing their use of energy services.

Customers are now able to light their homes longer to work or to study. They also benefit from increased access to information, entertainment, and connection via radio, television, stereo, and satellite dish. Existing businesses have been able to expand, and many customers have substantially increased their incomes by opening new businesses, which include butcheries, chicken hatcheries, corn mills, and hair salons.

security lighting, mobile phone charging, and to power small appliances such as radios and televisions.

The next three sites, serving approximately 1,500 people, were built in summer 2013 in the villages of Nyamondo, Matangamano, and Bara Nne. At 10, 20, and 50 kW, they are capable of supporting larger clusters of users, which include light commercial loads from customers such as welders, carpenters, and millers.

To scale its solution more broadly in Kenya, Powerhive began the process of seeking concessions in 2014. Concessions are an important tool for private-sector companies offering a public good and, in this case, provide the holder with the exclusive right to supply power in a given area for a number of years. By guaranteeing such exclusivity, concessions increase a provider's ability to attract financing, while being regulated as a utility opens the door to eligibility for government-sponsored incentives.

Powerhive-leveraged data gathered through its technology platform from its pilot projects when it applied for concessions. This data was used to demonstrate the true costs and benefits of electricity provision in remote areas to the Energy Regulatory Commission of Kenya (ERC).

In addition to demonstrating economic, environmental, and quality-of-life impacts, the data also provided proof of the microgrids' reliability, acceptance by local governing bodies, financial solvency, and safety. As a result, Powerhive was able to show that its microgrids offer a grid-quality service at a reasonable cost in off-grid areas. As a result, in February 2015, the ERC granted Powerhive's wholly-owned subsidiary in East Africa concessions to operate as Kenya's first privately held utility company.

This ERC decision set an important precedent in microgrid regulation. The concession will allow Powerhive to generate, distribute, and sell renewable electricity from microgrids to the Kenyan public. As a direct result of the Kenyan concession, Powerhive will significantly scale its off-grid utility service over the next year, constructing 100 microgrids – powered by First

Image: One of two Powerhive-backed beauty salons.

Solar's solar PV technology and operated with Powerhive's control technology—that will serve 100,000 residential and small business customers. The ERC's actions illustrate how regulators can unlock private-sector scalability through policy instruments.

As the Director of Economic Regulation for the Kenyan ERC, Dr. Frederick Nyang, wrote, "The Powerhive permit was granted in recognition of the fact that grid expansion is not always the most economical choice to expand energy access; off-grid alternatives have a role to play [...] Powerhive has demonstrated that its microgrids are capable of operating in compliance with the prescribed standards for residential and commercial electricity service provision."

Best Practices for Microgrid Regulation

Powerhive's experience in Kenya has provided the company with an understanding of the policy levers that can streamline deployment of microgrid solutions, as summarized below. These regulatory best practices will encourage financing and construction of microgrids by private-sector actors across un-electrified markets worldwide.

- **Seek electricity distribution concessions:** Concessions for electricity distribution have historically been granted to publicly owned utility companies that use regional-scale grid infrastructure. However, regulators must appreciate the role that microgrid service providers can play in delivering affordable access to energy in areas where grid expansion is an expensive undertaking. Concessions incentivize suppliers, while also making projects "bankable" to enable scale.

- **Establish cost-reflective tariffs:** Many national energy regulators have implemented fixed tariffs based on the cost of providing electricity to urban areas through the national grid. These fixed tariffs act as price ceilings that prevent the development of rural electrification projects, because tariffs based on urban cost data are insufficient to recoup the capital costs of electrification in rural areas. Regulators should allow energy service providers to set tariffs that are commensurate with the high capital costs of rural electrification. Powerhive's pilot data and market research have demonstrated that most customers are willing and able to pay for electricity so long as

it is priced fairly and below the cost of polluting alternatives such as kerosene and diesel.

- **Encourage risk-reflective rates of return:** During the last few years it has become clear that private-sector financing has the ability to fuel a major acceleration in the pace of rural electrification by enabling new off-grid solutions to reach scale. Governments endeavoring to achieve high rates of electrification should allow energy providers to offer their investors risk-reflective rates of return in order to attract the necessary private-sector financing.
- **Plan for future growth:** Regulators should give preference to appliance-compatible systems that can power income-generating activities, and to modular systems that can grow easily over time. Regulators also should plan for the future by clearly delineating how microgrids can retain their value when and if grid extension reaches communities served by microgrids. Ideally, microgrids will be able to connect to central grids in the future, providing their communities with resiliency from outages and serving as a generation source for the grid. Powerhive's success is largely due to the fact that its microgrids offer appliance-compatible AC electricity in sufficient quantities to allow usage growth over time.
- **Streamline regulation:** Regulators should amend existing guidelines for grid regulation to better fit the scale of microgrids. The level of red tape required for a multi-gigawatt utility-scale solar project could negatively impact the economics of a community-scale microgrid.

The Powerhive experience in Kenya has blazed a path for microgrid regulation in emerging markets that can catalyze growth of an affordable, clean, modern solution for energy access. If followed, these guidelines for regulators could bring effective microgrid solutions to unelectrified areas around the world that currently face severe limits to development.

About the Authors

Christopher Hornor is the CEO and founder of Powerhive, a leading microgrid solution provider in emerging markets. Powerhive's proprietary technology platform streamlines microgrid development and customer management, and it will soon provide 100% renewable electricity to 100,000 people. As CEO of Better Energy Systems prior to founding Powerhive, Mr. Hornor pioneered the first pay-as-you-go renewable energy service for remote, off-grid regions. He has delivered renewable energy to more than two million people.

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