The Bright Continent:

The Outlook for Utility-Scale and Commercial & Industrial Solar Projects in East Africa

December 2016

Report prepared by
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Contents

Acknowledgments and About the Author

Acknowledgements:

This study owes a debt of gratitude to Dan Reicher, the Executive Director of Stanford University's Steyer-Taylor Center for Energy Policy and Finance. Dan's Clean Energy Project Development and Finance course inspired an interest in solar project development and he later encouraged the author to pursue this study of solar development in East Africa. Dan's thoughtful edits and commentary were invaluable to this novice report writer.

Dozens of people provided their time and candid thoughts on the East African power industry. Sydney Larson, in particular, was tremendously helpful in getting connected to an energy community halfway around the world.

For Kenya: Kevin Gaitho, Cliff Aron, Jimi Akindele, Shadrack Kamau, Koffi Klousseh, Steven Meyer, Tomas Adcock, Charles Aloo, Eugene Odierno, Mark Hankin, Wakar Kalhoro, Mutisya Ndunda, Nicholas Tatrallyay, George Bowman, Alex Bashian, Matt Tilleard and Pieter Joubert. In addition, the author is grateful to Conrad Whitaker for his Nairobi hospitality.

For Uganda: Sarah Rowell, Andrei Klevchuk, Peter Nyeko, James Orima, Oscar Ankunda, David Rogers, Jay Patel

For Rwanda: Chaim Motzen, Trevor Green, Jean Claude Kalisa, Twaha Twagirimana, Eric Kariningufu, Gregoire Doucet, Chad Denning

For Tanzania: Steve Wasira, Fabio De Pascale, Peter Gathercole, Vernon Fernandes, Benjamin Fernandes and Jared Wren. Dustin Kahler provided both wind development expertise as well as a place to stay in Dar es Salaam.

Cover photo courtesy of Sameer Halai

About the Author:

Kent Kuran is pursuing an MBA and joint MS in Stanford University's Emmett Interdisciplinary Program in Environment and Resources (E-IPER). He developed a passion for renewable energy while working as a cross-border investment consultant in India and China.

A native of southern California, Kent sprouted an early interest in the history and politics of developing countries and has lived, worked, or travelled to over eighty countries. A summer 2015 internship in renewable energy investment banking was followed by a 1,500km August 2015 road trip from Mauritania to Guinea-Bissau. The West Africa trip left Kent wondering why the continent is trailing in megawatt-scale solar projects, and became the genesis for this study of utility and commercial scale solar PV in East Africa, a region frequently in the headlines for residential solar innovation.

Kent earned a BA in History, with a certificate in Near Eastern Studies, from Princeton University. He speaks Spanish and Turkish, as well as elementary French.

Key Terms and Acronyms

ACEF—Africa Clean Energy Finance
AFD—*Agence Francaise de Developpement* (Development Agency of France)
C&I—Commercial and Industrial. In this context referring to larger scale (100kW+) solar PV projects that provide energy directly to non-utility entities.
CSR—Community Social Responsibility
DEG—*Deutsche Investitions- und Entwicklungsgesellschaft* (German Investment and Development Corporation)
DFI—Development Finance Institution
East Africa—Shorthand for the four countries—Kenya, Uganda, Rwanda and Tanzania—researched for this report. These correspond to the East African Community (EAC), excluding Burundi.
EDCL—Rwanda's Energy Development Corporation Limited
EEP—Energy and Environment Partnership
ERA—Uganda Electricity Regulatory Authority
EUCL—Rwanda's Energy Utility Corporation Limited
EWSA—Rwanda's Energy, Water and Sanitation Authority
EWURA—Tanzania Energy and Water Utilities Regulatory Agency
FiT—Feed-in-Tariff
FMO—*Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden* (Netherlands Development Finance Company)
GETFiT—Donor funded subsidy of a FiT, utilized in Uganda
GHG—Green House Gas
HFO—Heavy Fuel Oil, a petroleum derivative commonly used in ships and some small-scale terrestrial thermal generation.
IFC—International Finance Corporation
IPP—Independent Power Producer
JAICA—Japan International Cooperation Agency
Kenya Power—State run owner and operator of most transmission and distribution in Kenya
KenGen—Kenya Electricity Generating Company, operating and developing much of Kenya's generation capacity.
KETRACO—Kenya Electricity Transmission Company Limited
KfW—*Kreditanstalt für Wiederaufbau* (German Reconstruction Credit Institute)
KW—Kilowatt, a unit of power capacity
KWh—Kilowatt hour, a unit of energy
LCOE—Levelized Cost of Energy
Norfund—Norwegian Investment Fund for Developing Countries
OPIC—Overseas Private Investment Corporation
PHS—Pumped Hydro Storage
Power Africa—White House initiative to double access to electricity in Sub-Saharan Africa
PPA—Power Purchase Agreement
RECO—Rwanda Electricity Corporation
REFiT—Renewable Energy Feed-in-Tariff
REG—Rwanda Energy Group
TANESCO—Tanzania Electric Supply Company Limited
UEB—Uganda Electricity Board
UEGCL—Uganda Electricity Generation Company
UETCL—Uganda Electricity Transmission Company Limited
Utility-Scale—Energy projects contracted to regulated utilities. Utility projects are typically 5 MW and above in developing countries.

Scope and Methodology

This study attempts to explain why sub-Saharan Africa (SSA) lags all other regions across the globe in large-scale solar photovoltaic (PV) deployments. The report zeros in on a cross-section of the continent—four vibrant and diverse countries forming the core of the East Africa region. The research scope (**Figure 1**) consists of Kenya, Uganda, Rwanda and Tanzania, a cluster of 150 million people. The investigation looks at on-grid utility-scale solar and commercial and industrial (C&I) projects, which can be either on or off-grid. The laudable innovations in small-scale solar deployments, such as on-grid and off-grid residential and off-grid solar micro-grids are not the focus of this report.

Primary research was largely conducted in December 2015 through onsite interviews with energy developers, investors, and power industry executives in Kenya, Uganda, Rwanda and Tanzania. The views of these industry participants are overlaid onto publicly available data on the East African power sector to form a snapshot of solar project development at the close of 2015.

FIGURE 1: Scope of Study

Geographies

Types of Solar

	Typical Size	On-grid	Off-grid
Utility-Scale	5+ MW		N/A
Commercial & Industrial (C&I)	20 kW – 5 MW		
Mini-grids	10 – 500 kW	N/A	
Residential	10 W – 10 kW		

In-scope

Out of scope

Executive Summary:

Modest Prospects for Utility-Scale Solar Projects

In East Africa (Kenya, Uganda, Rwanda and Tanzania) rising power demand is creating an urgent need for new generation. Expensive and inadequate power hobbles the development of manufacturing and is reducing economic growth by as much as 4 percent a year. Falling solar photovoltaic (PV) prices thus create a major opportunity in a region that enjoys a favorable solar resource.

Yet large-scale solar projects remain rarities in East Africa—outside of an 8.5 MW solar project in Rwanda, there are no utility-scale solar projects in operation in the region. Rwanda's success will likely be followed by limited deployments in each other East African country. On the current trajectory, perhaps 100 to 300 MW of utility PV projects will be built in these countries by 2020, complementing a current grid capacity of around 5,000 MW.

This is a notable development, but hardly transformative. No East African country is poised to enjoy the utility-scale solar booms experienced by some other developing countries. East African utility-scale solar deployments are challenged by difficult land acquisition, lengthy project approvals and contract negotiations, and solar energy tariffs that are too low to compensate investors for perceived payment risks. Utility-scale projects are contracted with national utilities in varying states of financial health. Kenya Power is considered a credit-worthy power customer, while Tanzania's TANESCO is not.

Deployments are highly dependent on the energy priorities of the governments, which have wide range of competing generation sources to pursue. East Africa is rich in generation potential ranging from hydropower and geothermal baseload power to natural gas (**Figure 2**). Kenya has ambitious plans to exploit its geothermal resource and to import coal while solar PV is a sideshow. Planned dams in Uganda are set to eclipse small utility solar projects under development. Methane from volcanic lakes and peat may become the favored new generation sources in Rwanda.

FIGURE 2: Installed Capacity, 2014, (MW)[i]

	Kenya	Uganda	Rwanda	Tanzania
Solar PV	2	-	9	-
Wind	24	-	-	-
Biomass	51	87	-	20
Geothermal	540	-	-	-
Small Hydro	102	67	80	34
Large Hydro	725	630	-	532
Coal	-	-	-	-
Natural Gas	54	-	4	527
Oil & Diesel	697	123	48	495
TOTAL	2,195	907	141	1,608

Yet in some the sunnier parts of the region, solar energy can be cost-competitive, and appealing to governments wishing to reduce dependence on imported fuels. Governments could further reduce the tariffs required by solar developers by addressing the issues that make such projects risky—land rights, slow project approvals and PPA negotiations, and poor credit quality of utility-offtakers.

Solar projects are capital intensive—PV assets operate for decades with minimal maintenance but require large upfront investments. Fortunately, project financing is not the barrier for utility-scale solar development in East Africa. While domestic banks are currently not capable of providing long-tenor, low cost, non-recourse debt, development finance institutions (DFIs) as well as a handful of intrepid equity investors are stepping in with project financing. Many investors feel that there is ample capital but a scarcity of quality utility-scale solar projects.

Even with ample financing and a minimization of project risks, there is only so much penetration that utility-scale solar can achieve in the short term. Energy planners must consider that solar PV is intermittent and non-dispatchable. Unless solar can be economically paired with storage solutions, it will likely remain a niche portion of East Africa's on-grid utility generation mix.

Promising Conditions for C&I Solar Development

In contrast with utility-contracted projects, Commercial and Industrial (C&I) solar PV projects are minimally regulated and largely depend on the energy economics of the businesses on which they are sited. As PV prices fall, innovations in credit and financing will allow C&I solar projects to proliferate over the next five years.

(C&I) projects have the potential to eclipse utility solar capacity in East Africa. Many businesses partially or fully depend on expensive diesel generation, which can be profitably offset by solar installations. As hardware and installation costs decline, solar is becoming cheap enough to compete with on-grid energy tariffs, which are extremely high in much of the region. C&I projects avoid the onerous government approvals and land acquisition challenges associated with utility projects.

C&I solar is in its infancy in East Africa, with less than a dozen projects completed to date. However, developers and investors are actively working to lower project costs, introduce project bundling, and provide developer liquidity in an effort to obtain faster and lower cost financing for these projects.

Introduction to Utility and C&I Solar in East Africa

Africa is the least electrified region in the world. In 1970, Sub-Saharan Africa enjoyed nearly three times the generating capacity per capita as South Asia. By 2000, the continent had fallen far behind other developing regions.[ii] Today, it is quite literally the "Dark Continent." The average East African uses less electricity than a typical resident of Cambodia. A Kenyan uses less than a third of the electricity as a Pakistani and a Ugandan enjoys one-tenth the electricity as a hermetically sealed North Korean.[iii] African generation capacity is low and transmission networks are extremely underdeveloped. Of the 43 countries globally with more than 50% of the population lacking access to electricity, 33 are in Africa. In East Africa (Kenya, Uganda, Rwanda and Tanzania), less than a quarter of the population has access to electricity (**Figure 3**).[iv]

FIGURE 3: Per Capita Electricity Consumption (1971 = 100)[v]

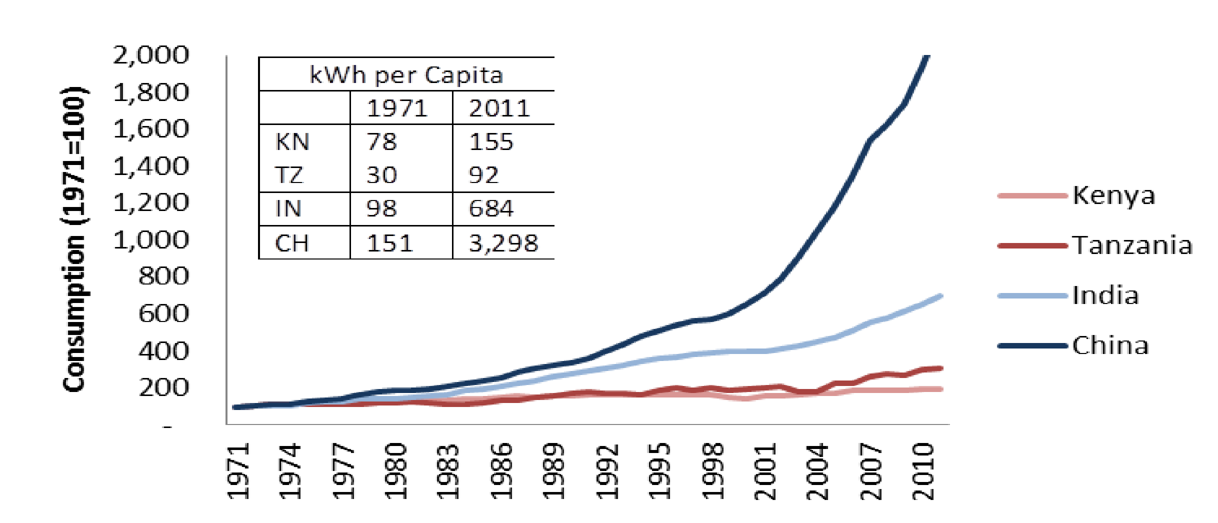


FIGURE 4: Electricity Capacity and Consumption by Country[vi]

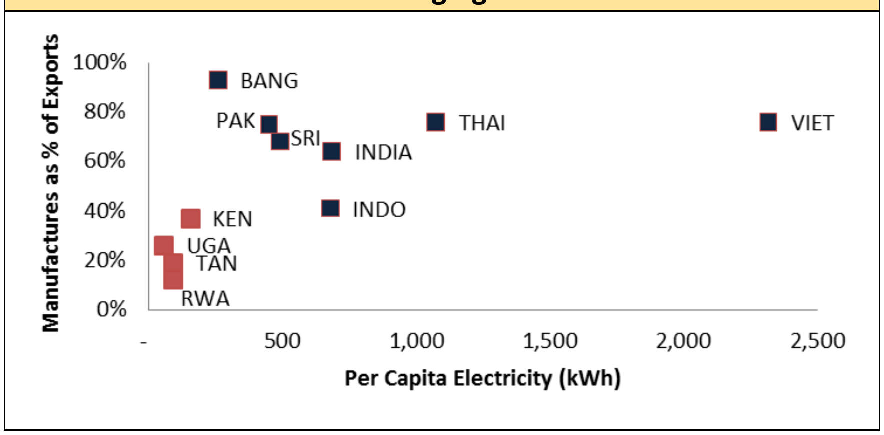
	Population (mm)	MW Installed (2014)	Per Capita kWh/year	% Access to Electricity
Kenya	47	2,195	155	23%
Uganda	34	907	57	18%
Rwanda	12	141	20	18%
Tanzania	55	1,608	92	15%
India	1,252	298,000	684	79%
China	1,357	1,481,000	3,762	100%
USA	318	1,086,000	13,246	100%

The lack of electricity dramatically hampers human wellbeing as well as economic growth in the region. For the hundreds of millions of Africans without electricity, nighttime brings profound darkness, only mitigated by expensive and dirty kerosene lamps. The inability to charge mobile phones, computers and to power televisions prevents participation in basic communications, as well as the digital revolution.

As the price of solar has plummeted in the past ten years, solar PV has become a viable part of the energy mix of developing countries. To date, however, most attention in Africa has been focused on micro solar systems—particularly leased or pay-as-you-go solar home systems. East Africa in particular has become an incubator of off-grid solar solutions. Kenya's M-Kopa pay-as-you-go systems already reach 275,000 homes.[vii] Powerhive is piloting solar microgrids in Kenya. Off Grid Electric, a micro-solar leasing company, raised over $70 million in 2015 to fund expansion in Africa. Overall, Africa-focused off-grid renewable companies raised over $200 million in 2015, compared to $64 million in 2014.[viii] Off-grid residential solar fills a tremendous gap in countries where much of the population has no near-term prospect of grid-connection.

Unfortunately, residential off-grid electricity can only be a partial solution to African electrification. Rural electricity access is an important objective but cannot provide the low cost and high volume concentrations of energy needed to support industrialization and sustainable economic growth. For the most part, Sub-Saharan Africa lags far behind fast-growing Asian countries in the proportion of its economy that is involved in manufacturing. There are many reasons that countries succeed in manufacturing but there is a strong correlation between power supply and manufacturing intensity (**Figure 5**). East African countries are not participating in the intensive export manufacturing in the way that their fast-growing and more electrified Asian competitors are.

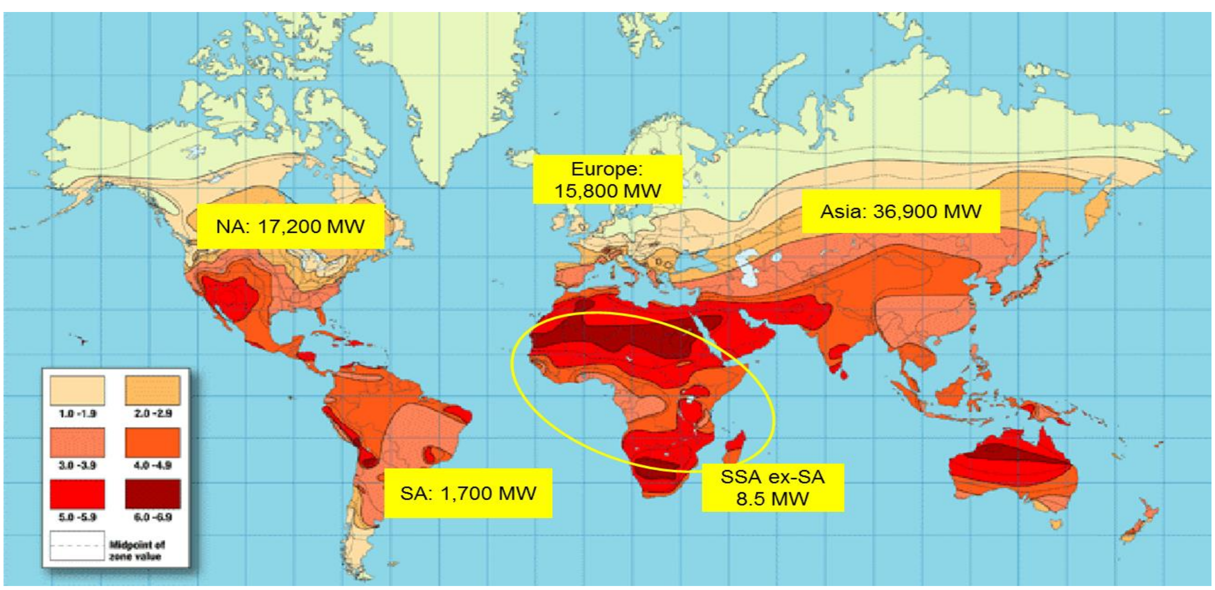
FIGURE 5: Electricity and Manufacturing Intensity in East Africa vs. Emerging Asia[ix]



Low electrification creates a tremendous missed opportunity for sustainable economic growth. Africa is expected to contribute 54 percent to global population growth by 2050. This increasingly populous continent might expect to absorb manufacturing jobs from Asia, where population growth is slowing and wages are rising. Yet a lack of reliable and cheap power hurts competitiveness. The World Bank estimates that electricity shortages reduce African economic growth by as much as 4 percent a year, or enough to halve economic growth over a twenty-year period.[x] The Bank also reckons that Sub-Saharan Africa spends just $11 billion per year on energy infrastructure, barely a third of the investment level needed to meet basic needs over the next two decades.[xi]

Africa generally needs to invest hundreds of billions of dollars in large scale, cost-effective power generation and transmission to achieve its 21st Century potential. At the moment, 75 percent of East Africa's population works in agriculture and nearly 80 percent of exports are commodities such as food products and minerals.[xii] To reach middle-income status, the region will need to build a viable manufacturing sector, which will require a dramatic expansion of cost-effective, high volume energy services. While off-grid residential systems will improve energy access to the many citizens living with little or no electricity today, industrialization is best supported by centralized and efficient generation. If solar is to play a role in East Africa's stronger economic growth and lighter environmental footprint, utility-scale and C&I PV deployments must become a much larger part of the picture.

FIGURE 6: Irradiance and Utility-Scale Solar Installations by Continent, Mid-2016[xiii]



In general, Africa is a sunny continent and thus offers power-dense project opportunities in many countries. Yet the continent lags far behind other regions in utility-scale power projects (**Figure 6**). At the start of 2016, only one project, has been completed in Sub-Saharan Africa (outside of South Africa)—Rwanda's 8.5 MW Rwamagana Solar Project, which was completed in July 2014. The Rwamagana project was an improbable triumph for its pioneering developers, European Development Finance Institutions (DFIs) and the technocratic and fast moving government of Rwanda. It was also a significant gain for the people of Rwanda, who saw their nation's generating capacity grow 6 percent overnight. Justifiably, the project generated significant media attention, as well as visits from international development celebrities such as Bono and Tony Blair.[xiv] The project in Rwanda, which is coincidentally built in the shape of the African land mass, seemed to usher in a new era for African power generation. If Rwanda could pull off a significant project, what was stopping other countries in the region? Was Rwamagana an aberration in continental development—a one-off project made possible by a generous energy tariff and a relatively efficient government? Or was Rwamagana the first in a major wave of utility-scale solar projects that would soon become a significant portion of the region's energy mix? Is East Africa on the cusp of the major solar booms experienced in Germany (2007-11), China (2011-), India (2012-) or Chile (2013-15)

This paper provides a primer on market outlook, government policy, and private business initiatives involving utility-scale solar in East Africa. It also reports on nascent efforts to deploy large PV systems for commercial and industrial (C&I) customers, a growing focus for solar developers around the world. The paper combines original primary fieldwork with secondary research from publicly available government documents, news articles, and policy reports. Most primary research was conducted over the month of December 2015, when the author travelled to Kenya, Uganda, Rwanda and Tanzania to interview approximately 35 renewable energy developers, project investors, and power sector policy experts. The resulting report aims to analyze the challenges of solar project development in East Africa and a realistic view of solar's position in the region's fast-growing power development.

The report is divided into utility-scale and C&I sections.

The first section assesses the outlook for utility-scale solar development in each of the four focus countries —Kenya, Uganda, Rwanda and Tanzania. Each sub-section introduces the relevant solar policies and investment conditions in light of the energy resource tradeoffs facing each country. These sub-sections also highlight one or more private efforts to develop a utility-scale solar project, though this report is by no means an exhaustive inventory of solar development efforts in the region. The final utility-scale subsection focuses on the availability of financing for this type of solar projects

The second section of the report highlights nascent efforts in Africa to develop captive

(C&I) solar projects. The section illustrates the favorable underlying market conditions for C&I solar, while identifying the credit and financing challenges that developers are now working to overcome in the space. Most insights are drawn from Kenya, which leads the region in C&I deployments.

The report wraps up with a brief conclusion.

SECTION 1: Utility-Scale Projects

1.1 Kenya Utility PV: Low Government Prioritization Challenges Utility Projects

As East Africa's largest and most sophisticated economy, Kenya might be expected to lead the region in utility-scale solar development. Yet the country has a broad range of non-solar options to grow its power sector, and as a result the government has not provided the institutional and financial resources to drive a boom in utility solar deployment. Nevertheless, a limited number of projects are being pursued despite tough operational conditions and relatively low solar tariffs.

1.1.1 A Strong Utility and IPP Framework

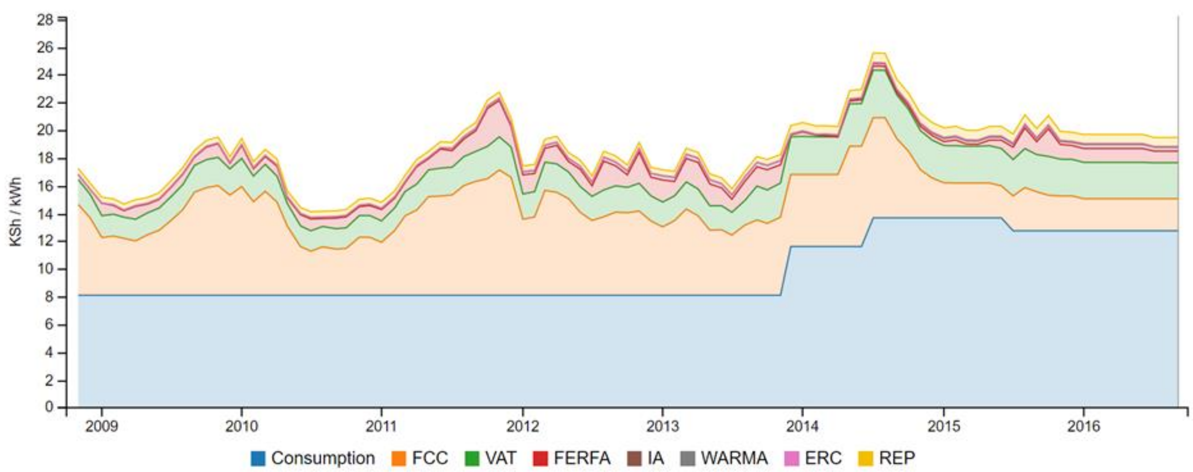
Like all the countries in the region, Kenya badly needs more power. Currently only 23 percent of the population has access to electricity and capacity for the population of 44 million is just 2,195 MW. Electricity demand grew by 5.6 percent between 2014 and 2015. The power sector is ripe for investment. In 2013, the incoming Kenyatta government announced plans to add a staggering 5,000 MW of power capacity, more than tripling the country's current generating capacity, within 40 months.

FIGURE 7: Installed Capacity, 2014 (MW)[xv]

	Kenya	Uganda	Rwanda	Tanzania
Solar PV	2	-	9	-
Wind	24	-	-	-
Biomass	51	87	-	20
Geothermal	540	-	-	-
Small Hydro	102	67	80	34
Large Hydro	725	630	-	532
Coal	-	-	-	-
Natural Gas	54	-	4	527
Oil & Diesel	697	123	48	495
TOTAL	2,195	907	141	1,608

To attract the capital to meet these ambitious power sector goals, the country is fortunate to have a national utility, Kenya Power and Lighting Company ("Kenya Power"), which is regarded as the most credit-worthy in the region.[xvi] In existence since the colonial period, the modern Kenya Power is a result of recent power sector restructuring where state-owned generating assets were spun off into the Kenya Electric Generating Company ("KenGen") and new transmission operations into the Kenya Electricity Transmission Company ("KETRACO"). Kenya Power retains control of the existing transmission infrastructure and the national distribution monopoly and has never defaulted on payments. Like other regional utilities, Kenya Power pays Independent Power Producers (IPPs) contracted dollar-denominated tariffs, which reduces currency risk for power investors. And unlike some utilities, notably Uganda's, Kenya Power also pegs retail power rates to the dollar. While this leads to somewhat volatile power prices for residences and industry (**Figure 8**), it allows the company to more closely match income with its generation costs, which are often in dollars. In effect, Kenyan consumers absorb currency risk on behalf of the utility and power generators. Though Kenyan customers might face higher electric bills during periods of weak currency, a more stable investment climate for IPPs will ultimately lead to more generation and energy access. The creditworthiness of Kenya Power and reduced currency risk of projects are viewed as key enabling factors for the eight independent power projects that have been undertaken in Kenya since the market was introduced to IPPs in the 1990s.[xvii] These projects have focused on gas, diesel and geothermal projects, and now make up approximately 20% of generation capacity.[xviii]

FIGURE 8: Kenyan Domestic Retail Tariffs, 2009-16 (KSh / kWh)[xix]
1 US$ = 102 KSh



Despite these structural advantages, Kenya has roundly failed to meet government targets for new generating capacity. More than half-way through the 40-month goal of 5,000 MW, a mere 280 MW of new capacity has come online. Most of this capacity has come from two geothermal plants developed by KenGen, one of two state-owned companies tasked with developing the Rift Valley geothermal resource, which is believed to exceed 10,000 MW in potential.[xx]

Utility-scale solar projects have been similarly slow to develop, and it appears unlikely that any will come online before 2017. The development of utility-scale solar projects has been constrained by 1) unattractive Feed-in-Tariffs for solar IPPs, 2) land acquisition issues for developers and 3) the slow and inefficient processing of project proposals by the government.

1.1.2 Unattractive Feed-in-Tariffs for Solar IPPs

Kenya's Energy Act of 2012 established fixed Feed-in-Tariffs (FiT) according to the type of generation and size of power project (**Figure 9**). The solar FiT was fixed at $0.12/kWh, for a 20-year period, with minimal scope for annual escalation.[xxi] This is low by regional standards—between 30-50% lower than the PPA signed in Rwanda[xxii] and a $0.163/kWh solar PPA negotiated in Uganda.[xxiii] Egypt, a desert country with higher levels of irradiation than Kenya, offered a $0.14 FiT in late 2014..[xxiv]

FIGURE 9: Kenya FiT for Renewable Energy Projects (December 2012)[xxv]			
	Installed Capacity (MW)	Standard FiT (US$/kWh)	Percentage of Tariff Adjustable to Inflation
Wind	0.5 - 10	$ 0.11	12%
	10.1 - 50	$ 0.11	12%
Hydro	0.5 - 10	$0.0825 - 0.105	8%
	10.1 - 20	$ 0.0825	8%
Biomass	0.5 - 10	$ 0.10	15%
	10.1 - 40	$ 0.10	15%
Geothermal	35 - 70	$ 0.088	20%
Solar (On - Grid)	0.5 - 10	$ 0.12	8%
	10.1 - 40	$ 0.12	12%

As of late 2015, the $0.12 FiT was widely seen as a major impediment to utility power projects in Kenya. Shadrack Kamau of Biashara Energy, an energy developer in the Mount Kenya region, was focused on wind projects over solar because both have similar FiTs (wind is $0.11), though large-scale wind has lower project costs.[xxvi] Cliff Aron of GreenMax Capital Advisors, a renewable energy advisory firm active in Africa, believes that the $0.12 tariff effectively caps solar project equity returns at 13-14%, below the 16-20% targeted by most East African power developers.[xxvii] Other developers and investors saw $0.12 as workable only if many other factors are favorable. Koffi Klousseh of the IFC suggests that $0.12 may be uneconomical for developers without either concessional (<5%) debt financing or subsidized work from the project EPC.[xxviii] Another industry insider said that $0.12 can be sufficient if land is acquired cheaply and the project is close to transmission, though these conditions are not found in most areas of Kenya.[xxix] For example in 2015, a landowner proposed a 200 MW solar project in the Rift Valley but the required 32 km spur to the nearest high capacity transmission line meant that project costs could not work with a $0.12 tariff.[xxx] Eugene Obiero of Camco Clean Energy, an energy advisory firm and investor, described $0.12 as low, though increasingly feasible due to declining component costs of solar.[xxxi] Tomas Adcock of Kenergy, in advanced stages development of a 40 MW solar project in North Central Kenya, called $0.12 "tight" in the 2015 market given the tax and regulatory framework in Kenya. Adcock says that the tariff does work but only with aggressive EPC pricing, highly concessional debt and complex tax structures to enable foreign investors to repatriate profits. He also noted, however, that as solar costs continue to fall, the Kenyan tariff is becoming more widely viable.[xxxii] It appears that the $0.12 FiT may be just enough to attract and finance a few projects that manage to achieve low land and constructions costs, but currently not high enough to encourage the sort of solar project bonanza observed in some developing countries.

Because the Kenyan government has access to other conventional and renewable generation opportunities, there is little political will to raise the solar FiT. As nearby countries continue to lower their own solar tariffs, Kenya might even be tempted to reduce the $0.12 FiT. The government may discount the considerable challenges in developing solar projects in Kenya, while looking enviously at markets such as the UAE or India, where single-digit solar FiTs have been observed in some circumstances.[xxxiii] If Dubai can receive solar bids for $0.03/kWh, Kenyan officials may ask themselves why they should offer $0.12, perhaps forgetting that the Dubai projects might enjoy cheaper land, faster development timelines, comprehensive import duty exemptions, larger project scale, better sun, and possibly cheaper financing.[xxxiv] It is also far from assured that all "bargain" projects will ever get financed and built.

Kenyan energy officials can also look to multiple alternative sources of conventional and renewable energy. The government has pushed forward the development of a 981 MW coal power station on the coastal city of Lamu, which will transmit power to Nairobi and the central highlands. The $2 billion project is being largely financed by the Industrial and Commercial Bank of China (ICBC), as the international donor and development community now largely shuns emission-heavy coal projects.[xxxv] In addition to being carbon intensive, critics also point to the challenges of integrating 981 MW of relatively inflexible base-load power into a grid that currently stands at barely 2,000 MW. It is also doubtful that the high-emissions Lamu coal plant will allow Kenya to meet its publicly stated climate goals. In the Paris Climate Change Agreement of 2015, Kenya published a Nationally Determined Contribution (NDC) that targeted 30% abatements in GHGs, where a business-as-usual scenario forecast a doubling of GHG emissions by 2030. The NDC proposed a prioritization of "geothermal, solar and wind energy production" and made no mention of coal-fired generation.[xxxvi] Despite these concerns, the Lamu coal project is politically favored in Nairobi and is expected to come online in 2017. Overall, the Kenyan government's coal efforts appear to be distracting major resources and initiative away from the solar sector.

Solar also must compete with other abundant renewable resources in Kenya. Parts of Kenya enjoy strong wind speeds and the Lake Turkana (300 MW under construction) and Meru (400 MW being planned) would add a combined 700 MW to the grid.[xxxvii] While existing geothermal capacity is limited, the country is thought to have as much as 10,000 MW of unexploited geothermal resources, making it potentially the world's largest geothermal country (today's leader, the US, has just 3,442 MW installed geothermal capacity)[xxxviii]. Kenya's vast geothermal potential is likely the main reason why on-grid solar is a secondary priority for the Kenyan government. Geothermal is a clean and steady source of power with favorable unit economics when exploited at scale. And there are few countries with such high geothermal potential—with ongoing exploration discovering more. Kenya hopes to exploit 2,500 MW of geothermal power within five years.[xxxix] Two Kenyan state owned companies, KenGen and Geothermal Development Corporation (GDC) are driving the development of geothermal power. As of December 2015, KenGen has succeeded in building 280 MW through the expansion of the Olkaria project.[xl] GDC, by contrast, has not succeeded in bringing any geothermal steam blocks to production, despite technical guidance from PowerAfrica, a U.S.-led ombudsman created by the Obama administration in 2013 to channel expertise and funding to African renewable power.[xli] Another 100 MW geothermal project, developed by US-based OrPower, reached financial close in April 2016.[xlii] Nevertheless, the eventual exploitation of Kenya's geothermal resource could bring grid-management challenges. Geothermal plants suffer major water loss from steam venting when plants are ramped down, and are therefore rarely turned on and off. A geothermal and coal-dependent grid will therefore have a high volume of constant base-load power, which will rarely be turned off. Short-term dispatchable power sources such as hydro and oil/diesel will continue to be needed to cover peak demand.[xliii]

Kenya also has considerable hydropower resources, with the prospect of developing more. Under the Feed-in-Tariff structure implemented in 2012, hydropower projects can contract for power delivery at $0.0825/kWh, and as much as $0.105 for smaller projects. Generally, the country has used hydropower as a cheap baseload and has also entered contracts with neighboring Ethiopia to begin importing hydropower (400 MW contract signed). As structured, hydropower rates are low and therefore in competition with solar production. If restructured, hydropower could potentially complement solar, by providing dispatchable power when solar is not producing. Kenya might implement tiered pricing to encourage hydropower facilities to dispatch energy during peak demand periods or when there is a deficit in solar production. At present, however, there do not appear to be such plans to use hydropower to support the expansion of solar projects on the grid.[xliv]

With multiple energy alternatives, solar has not figured highly in Kenyan power sector planning. Solar can be seen wholly absent from some government capacity projections. For example an October 2012 presentation by KenGen forecasted a 2030 generation target of 17,764 MW which included sizeable investments in geothermal, coal, imported hydro, wind and nuclear power, but no explicit mention of solar.[xlv] The 2013 Least Cost Power Development Plan (LCPDP) also does not specifically mention solar targets.[xlvi] Kenya's Nationally Determined Contribution (NDC) unveiled at the 2015 Paris Climate Convention referenced solar development without providing details.

Even if geothermal ultimately becomes Kenya's dominant form of renewable energy, the long and challenging geothermal development process might encourage utility-scale solar projects in the coming decade. Geothermal projects involve a development process of six years or more.[xlvii] By contrast, solar projects are less complex, and can theoretically come online within about a year from financial close, assuming no major issues involving transmission or storage. Kenya's need for grid power capacity is pressing and there is compelling "low hanging fruit" that could be economically addressed by solar projects. The Kenyan grid currently depends on between 300-400 MW of diesel and heavy fuel oil (HFO) generator capacity, which runs at a variable cost of $0.30/kWh or more.[xlviii] The government may be holding out for a future built on inexpensive and steady geothermal power, but in the meantime, parts of the grid are served by dirty and expensive diesel which could be rapidly and economically displaced by utility solar projects.

With a politically-favored coal complex coming online, cheaper wind power potential, and an abundant geothermal resource, there is little political will to raise the $0.12 solar FiT to attract more development. International donors are said to have discussed implementing a GETFiT scheme, whereby donors top up project tariffs until they satisfy the investment hurdles of project sponsors. This scheme has been run successfully in Uganda (see next section). The Kenyan government, however, declined to adopt the GETFiT scheme, preferring that the donor community channel the funds to higher-priority initiatives.[xlix]

1.1.3 Land Acquisition and Community Engagement in Kenya

Achieving solar projects with a $0.12 FiT is especially challenging in Kenya due to the extraordinary difficulties of obtaining secure land rights and developing greenfield projects in populated areas. While land acquisition and titling can be complicated in many African countries, Kenya's legacy of European settlement and modern "tribal" conflict have heightened sensitivities over land acquisition. Indeed, land rights were central to the communal violence which followed the contested 2007 elections—many of the over 1,000 slain in the post-election violence were ethnic Kikuyus resented for "squatting" on Rift Valley land traditionally used by other ethnic groups.[l] The subsequent 2010 constitution barred foreigners from obtaining freeholds on Kenyan land. While most solar developers with finite PPAs would prefer to lease rather than own land, leasing can be challenging as well. In Kenya, foreigners are prohibited from leasing land classified as "agricultural", so project sites involving this kind of land must be reclassified in a slow bureaucratic process in Nairobi.[li]

Kenyan energy developers describe a land acquisition process that is slow, high-touch and insecure. Navigating competing land titles spanning the British and post-independence period may only be the beginning, as land rights may be challenged or projects effectively blocked by one or more local players. With inadequate political and institutional protection for foreign landowners, any influential local has the potential hold up a project. Therefore, developers spend an enormous amount of time and money to build and maintain community support, which can be the only way to fully ensure the viability of land acquisition, project construction and uninterrupted operation.

Community engagement efforts are highly involved and costly. One Kenyan power developer identifies 15-20 of the most influential "elders" around a prospective site and installs them on (sometimes paid) committees to determine appropriate community compensation measures, including local development projects and project hiring decisions. These community projects must be administered directly by the developer to avoid being overcharged by local agents. They may also distribute 2 percent of project equity to these local committees, as well as 4 percent to county governments, a hefty contribution for a developer who hopes to retain at most 20 percent of project equity.[lii] Another developer of a 40 MW solar project echoed the high cost of enabling the sustainable acquisition and use of land for energy projects. Tomas Adcock of Kenergy estimates that the company has committed well over 2,000 hours of staff time to land rights and community issues on one project. The firm has identified 80 local people of influence who they aim to communicate with at least once a quarter. They have hired a full time employee solely for this purpose. In all, Adcock believes that a highly disproportionate amount of his firm's time is attributable to securing and maintaining durable land rights in Kenya.[liii] Another investor in Kenyan energy projects pegs Kenyan direct land acquisition costs at 20% of pre-construction development, high by international standards, and adds that developers have tremendous difficulty finding competent and trustworthy staff to handle the critical community liaison function.[liv]

While these intensive local engagement efforts may seem excessive, the story of two wind projects shows why it is critical to invest in good community relations. Investors have recently abandoned the 65 MW Kinangop Wind Project after acrimonious disputes with local political leaders made the project unviable.[lv] With inadequate community engagement, the project quickly became unpopular with locals. Regional politicians exploited this tension to lead protests against the project, and at a time the construction site was barricaded, causing major project delays. In the end, misunderstandings on the ground had a severe impact on investors, who included Norfund and the African Infrastructure Investment Managers (AIIM).[lvi] By contrast, the 300 MW Turkana project, developed by Aldwych International and Vestas, involved more robust community engagement. The developers built schools and roads and ensured that at least 20% of the project workforce was local. The first two test turbines were also dedicated to providing power for the community. Consequently, Turkana is popular with the community and the project has not seen major disruptions due to disputes over land ownership and development.[lvii]

With land being such a critical and difficult issue in Kenyan project developments, those who have unfettered access to appropriate property are often in a favorable bargaining position. Charles Oloo of Altener Energy, a Kenyan developer, has seen landowners demand 20 percent project equity, whereas he believes a $0.12/kWh FiT solar project could only spare 5 percent equity to facilitate land acquisition.[lviii]

1.1.4 Procedural Challenges for Kenyan Utility-Scale Solar Projects

Caught between daunting land use challenges and a relatively low $0.12 FiT, Kenyan solar project developers would be well served by a smooth and fast process to obtain PPAs. [Explain] Unfortunately, the process is rife with bottlenecks.

Kenya currently offers a fixed FiT to solar developers, in contrast with the reverse solar tender process employed by Uganda and the bespoke negotiation processes witnessed in Rwanda and Tanzania. In Kenya, developers submit an Expression of Interest (EOI), which is reviewed and approved by the Ministry of Energy (MoE). Subsequently, the Energy Regulatory Commission (ERC) grants an IPP license. The IPP license gives the developer the theoretical "right" to obtain a $0.12/kWh solar PPA from Kenya Power, the national utility. The approved EOI provides the developer an exclusive 18-36 month window to pursue development of the site and negotiate the PPA. While PPA negotiation is ongoing, the developer will conduct the project feasibility study, obtain required land use permits, and submit to an Environmental Impact Analysis (EIA), completed by a firm licensed by the National Environmental Management Authority (NEMA). Overall, one developer estimated that a completed project requires 80-100 individual approvals at various levels of government.[lix]

The devolution of authority from Nairobi to the counties, mandated in the 2010 Constitution, and still in the process of implementation, may be adding further complexity to the projects. Site permits that may have once been processed in Nairobi ministries are increasingly being approved by county-level officials. This may be good news for smaller-time Kenyan developers with extensive relationships with local officials, but for larger developers operating out of Nairobi, devolution merely adds another layer of government relationships to navigate.[lx] Kenya's 47 county governments may not all have the human resources to properly process some highly technical permits and reviews.

Kenya Power's PPA is an ostensibly non-negotiable, take-it-or-leave it document. Unfortunately, it contains some terms that would severely challenge a plant operator. For example, the Kenya Power PPA does not compensate solar projects for deemed power, which effectively saddles the IPP with curtailment risk. In practice, Kenya Power regularly negotiates this "fixed" PPA and "bankable" terms have been added to the PPAs. However, this unnecessarily raises the perceived risk of projects. Developers are forced to convince early-stage equity investors that a theoretically non-negotiable PPA will eventually be fixed through negotiation.[lxi] The World Bank has launched the Scaling Solar initiative to ease PPA negotiations around Africa. Scaling Solar has proposed a standardized, best-in-class PPA document used in South Africa's successful round of solar tenders. The document has been well received in a few African countries, but has not been adopted in Kenya or East Africa more generally.[lxii]

As more IPPs attempt to win energy contracts in Nairobi, the PPA negotiation process has become more and more of a bottleneck. Multiple Kenyan power industry insiders believe that the bar to earn ERC approval of a project EOI is too low, allowing many underdeveloped or unviable projects to reach the Kenya Power PPA negotiating table.[lxiii] As of December 2015, there were thought to be 22 PPAs under negotiation or very recently concluded, of which seven are solar.[lxiv] Since there are a limited number of Kenya Power officials with the authority and skillset to negotiate PPAs, this has drawn out negotiating timelines for good projects. One developer disclosed that times between turns on a solar PPA document had grown to six weeks or more, though the pace has picked up in recent months.[lxv]

Bureaucratic disputes over the delineation of "solar" import duty exemptions can also cause delays on solar projects. The typical Kenyan import duty ranging from 0 to 25 percent would greatly add to solar project CAPEX and challenge project economics in Kenya. The government exempts "solar equipment", which is narrowly defined as solar modules, but not balance of system equipment. The government is wary of traders who might abuse the solar equipment exemption to import electrical equipment that are not actually for use in solar PV systems. Therefore developers are required to obtain special permission from the ERC to import balance of system hardware such as racks, inverters and tilt systems.[lxvi] This simple issue has temporarily impeded at least one project in Kenya and another in Uganda.

1.1.5 Persistence Will Pay Off for Pioneering Developers but Utility Solar Boom is Unlikely in Kenya

In the right circumstances, Kenya, a country with high irradiance in certain counties and the region's most creditworthy utility could be the epicenter of utility solar projects. Unfortunately, bureaucratic and process challenges, as well as institutional barriers to land acquisition and development, have prevented Kenya from rapidly exploiting its solar energy potential. Competing energy generation options have led to a solar FiT that only thinly rewards developers intrepid enough to work through these challenges. Nevertheless, some projects will likely close in 2016 and 2017. As of December 2015, there were thought to be seven solar projects under PPA negotiation, of which four to five were actively being negotiated in the last quarter of 2015.[lxvii] How many of these PPAs will be signed and how many projects will be built is subject to rumor and debate. One expert says that a 50 MW Chinese-developed solar project is advancing quickly, while another says that it is a very distant prospect. In July 2015, Canada's Skypower announced an intention to develop 1,000 MW of solar power over 5 years, echoing other eye-popping but unrealized announcements made in Egypt and Nigeria. In the end, however, a handful of solar PPAs will likely be signed, and it is not hard to imagine 100 MW to 150 MW of utility solar projects being built, or certainly reaching financial close, in Kenya in the next two or three years. While not a transformative figure, this is equivalent to two million 50-watt panels, easily surpassing the rollout of off-grid residential systems in Kenya.

Kenya Utility-Scale Solar Development Outlook	
Reasons to Build Utility Solar	**Reasons not to Build Utility Solar**
• Diversification from hydropower • No requirement of expensive fuel imports • Low air and noise pollution and GHG emissions • Quicker to bring online than geothermal	• Competition from hydro, wind, geothermal and coal alternatives
Attractions for Investors	**Challenges for Investors**
• Large economy by regional standards • Most solvent utility off-taker (Kenya Power) in region • High irradiance in highland regions • Well established FiT framework	• Low FiT challenges smaller PV projects • Challenge to acquire land • Lengthy approvals and bureaucratic inertia • Ambiguity around solar import duties

1.2 Uganda Utility PV: Donor Subsidies Enable Solar Diversification from Hydropower

Throughout its modern history, Uganda has been highly dependent on hydropower for the bulk of its power. While hydropower provides an inexpensive and dispactchable energy source, droughts have driven home the need to diversify the grid. Faced with drought-driven shortages in the 2000s, the government began to commission turnkey diesel and heavy fuel oil (HFO) plants, an expensive and polluting short-term solution. As solar costs have dropped, a greater focus has been placed on PV projects and two utility-scale projects are likely to be built in 2016. These projects were, however, made possible by partial donor tariff subsidies and it remains to be seen if subsequent projects can be viable without external subsidies.

1.2.1 A Hydropower Strategy

Since the 180 MW Nalubaale dam was built by the British in 1954, Uganda has been powered by Nile River hydropower. To this day, hydro represents 695 MW, or 78 percent of the country's installed capacity of 895 MW.[lxviii] This strategy has made Uganda vulnerable to droughts and a boom-bust-cycle of emergency thermal capacity additions. In 2007, Jacobsen Elektro AS, a Norwegian turnkey energy provider, built a 50 MW heavy fuel oil (HFO) plant in Namanve, outside of Kampala.[lxix] Shortly thereafter, ElectroMaxx, became the first indigenous African independent power producer when it won a contract to build and operate an 80 MW HFO plant in Tororo, eastern Uganda. Then in 2012, the 250 MW Bujagali hydroelectric plant came online bringing the country's generation capacity to over 800 MW. At the same time a successful program by the Uganda Electricity Transmission Company Limited (UETCL) reduced line losses from 36 to 27 percent by 2012, allowing the country to comfortably meet a 2015 peak demand of 540 MW.[lxx] With new hydropower capacity and improved transmission, the utility all but shuttered ElectroMaxx's and Jacobsen's recently built thermal plants, which depended on high-cost fuel. At present, both the ElectroMaxx and Jacobsen plants are contracted by the government to run at just 7 MW of capacity.[lxxi]

FIGURE 8: Installed Capacity, 2014 (MW)[lxxii]

	Kenya	Uganda	Rwanda	Tanzania
Solar PV	2	**-**	9	-
Wind	24	**-**	-	-
Biomass	51	**87**	-	20
Geothermal	540	**-**	-	-
Small Hydro	102	**67**	80	34
Large Hydro	725	**630**	-	532
Coal	-	**-**	-	-
Natural Gas	54	**-**	4	527
Oil & Diesel	697	**123**	48	495
TOTAL	2,195	**907**	141	1,608

Though Uganda's on-grid power demand is currently being met, rapid demand growth will require continued commissioning of new capacity. National grid power consumption remains low, at just 57 kWhs per capita compared with 684 in India and 13,426 in the U.S. (see **Figure 4** above). Only 18 percent of the population is served by grid electricity, though transmission expansion is growing rapidly. 3,670 km of medium voltage transmission lines were commissioned in 2013 alone. [lxxiii] The expansion of the national grid in an economy growing at over 5% a year could drive on-grid electricity annual demand growth of 10 percent or more. The Ugandan Government's 'Vision 2040' targets per capita electricity consumption of 3,668 kWh (a 60-fold increase) and grid access of 80 percent.[lxxiv] In the near-term, the government plans to meet burgeoning demand with three planned hydroelectric plants on the White Nile River, developed by Chinese firms. The 600 MW Karuma project and the 183 MW Isimba projects are expected to be completed by the end of the decade, while the 600 MW Ayago project may follow by 2023. Combined, these large dams would nearly triple Uganda's current generation.[lxxv]

1.2.2 Donor-Funded Tariff Subsidies Kickstart Solar Construction

Against the backdrop of a fast expanding, low-Levelized Cost of Energy (LCOE) hydropower baseload, utility-scale solar PV projects are proceeding slowly. The 2007 Renewable Energy Plan identified 200 MW in solar power potential, but did not set any capacity targets, citing a prohibitively high solar installation cost of $12-15/W.[lxxvi] Even as installed solar costs began to plummet, solar remained an afterthought. When the Energy Regulatory Agency (ERA) issued a revised Renewable Energy Feed-in Tariff (REFiT) in November 2012, solar power was listed as a possible source of procured renewable power, but no specific REFiT was ascribed to solar. Oddly, the same document declared a $0.124/kWh REFiT for wind power, even though low wind speeds make this technology unattractive in Uganda.[lxxvii]

Even if this $0.124/kWh had been applied to solar, it would have likely been too low to attract solar developers to modest-sized projects in Uganda. This prompted international donors to step in to subsidize solar tenders.[lxxviii] In 2013, a consortium of international donors, including Germany's KfW development bank, the UK's Department for International Development (DFID) and Norway's Norad and Norfund, partnered with the Uganda's ERA to set up the GETFiT program. The GETFiT is a pooled donor commitment to subsidize the difference between the Ugandan government's tariff and lowest IPP tariff bid for energy projects. The GETFiT aimed to fast track as many as 15 projects for a targeted 125 MW of capacity.[lxxix]

The GETFiT initially tracked the Uganda's REFiT policy, which had fixed wholesale tariffs for small hydro and wind, but not for solar. In 2014, inspired by a successful reverse "Dutch" auction round for South African solar projects, the GETFiT was expanded to include solar projects. Uganda decided to apply its $0.11/kWh small hydro tariff for solar projects, a tariff even lower than Kenya's $0.12, and the $0.14 being offered in sunny Egypt. 20 MW of solar were tendered in 5 MW blocks, with the ERA committing to pay the $0.11/kWh REFiT established for small hydro and GETFiT's donors agreeing to pay the balance of the winning tariff bids, which were expected to come in between $0.15-0.20/kWh. Crucially, the GETFiT tariff payments are frontloaded such that developers receive 50% of the amortized payments upfront, and the balance in the first five years of the projects, which are contracted as 20-year PPAs.[lxxx]

1.2.3 Two Utility Solar Projects to be Built within Year

The 2014 solar REFiT/GETFiT tendering process generated 24 EOIs, of which nine were pre-qualified and seven ultimately submitted bids reviewed by the ERA and UETCL, the Ugandan transmission company which purchases wholesale power.[lxxxi] The ERA and UETCL ultimately awarded two 10 MW concessions for a total capacity of 20 MW.

One 10 MW tender was won by Access Infra Africa, a development JV between Dubai-based Access Power and France-based EREN Renewable Energy. Spain's TSK Electronica is the project EPC and project debt financing has been committed by FMO, the Dutch development bank, and London-based Emerging Africa Infrastructure Fund.[lxxxii] The 10 MW project is located in Soroti, a sunny region of northeastern Uganda. The project site consisted of arid and uninhabited land requiring no relocation of families. The site is 3.5km from the Soroti substation that will provide a grid interconnection.[lxxxiii] Construction began in March 2016[lxxxiv]

The second solar REFiT/GETFiT 10 MW concession block was awarded to a consortium led by the Simba Group, a Ugandan conglomerate, and Building Energy SpA, an Italian integrated developer, EPC and operator of global renewable energy projects. The project was sited in Tororo for several reasons. First, the area is located in the sunnier east of Uganda, in a district near Lake Victoria with insolation of 6.7 hrs/day (comparable to California's Central Valley). Secondly, the 50 MW ElectroMaxx thermal plant, of which Simba is a shareholder, already operates in Tororo, which made it easier to acquire land from a known and trusted party. Finally, the Tororo site is around 1km from the major Uganda Electricity Transmission Company Limited (UETCL) substation and is adjacent to the main Mombasa highway for ease of logistics.[lxxxv] Building Energy is the lead EPC, and project debt financing is being arranged with FMO, the Dutch development bank, and London-based Emerging Africa Infrastructure Fund.

Developers must take land acquisition very seriously in Uganda. As in Kenya, private landowners cannot be forced to sell land, and inadequate attention to community engagement can derail projects. [lxxxvi] The Simba Group therefore faced advantageous circumstances in pursuing the Tororo project because the project site was not settled and the land was owned by one party already known to the group.

The winning bids for both solar projects were $0.163/kWh, with UETCL committing to pay $0.11 and the GETFiT donors paying the additional top-up in lump sum payments over a 5-year period. Upon winning the concessions, the Simba Group undertook approximately six months of negotiations with the UETCL on a PPA that had to be adapted from a standard PPA designed for hydropower projects. The negotiations culminated in a "bankable" and standardized solar PPA that included crucial provisions for deemed power and mitigation of curtailment risk.[lxxxvii]

As we have seen in Kenya, uncertain tax treatment of solar hardware imports can complicate projects, and this is also an issue in Uganda. Following the conclusion of the PPA negotiations, financial close for the Tororo project was delayed as the developers worked with the government of Uganda to clarify the tax treatment for solar. This was primarily around VAT treatment of solar plants, which are disadvantaged versus hydropower plants. An amendment to the VAT Act to match the treatment of hydropower is currently being considered by the Ugandan Cabinet and Parliament and final resolution is expected in Uganda's 2016-17 national budget.

Also near Tororo, a group of investors tied to the Aga Khan Foundation have obtained a Feasibility License to build a 50 MW solar project. While the project will fall outside of the donor-funded GETFiT subsidies, the deep-pocketed Aga Khan network is expected to mobilize cheap debt and concessionary financial terms to enable the project.[lxxxviii] Elsewhere, near the northern town of Gulu, Kampala-based Earth Energy proposed to build a 20 MW solar-biomass hybrid project. However, the government believed that a large solar project (even one firmed up with some biomass) would be too intermittent for the small and underdeveloped Northern grid network. The utility directed the company to pursue a biomass plant alone. Earth Energy was assisted by a $150,000 KfW grant for pre-feasibility work and as of December 2015 was seeking $1 million in development equity to complete pre-construction development.[lxxxix]

1.2.4 Utility Sector Decoupling Makes Solar Off-takers More "Bankable"

Structural reforms in the power sector have made Uganda a viable destination for independent power producers. The 1999 Uganda Electricity Act 145 unbundled the vertically integrated Uganda Electricity Board (UEB) into three separate entities: the Uganda Electricity Generation Company (UEGCL) the state run generation company; the Uganda Electricity Transmission Company Limited (UETCL), responsible for high voltage transmission; and Umeme, the national distributor.[xc] The rationale for utility unbundling is that each entity is able to price power in a way that more accurately reflects true arms-length costs. If, for example, an independent generator requires $0.10/kWh to remain in business, and the independent transmission and distribution companies each have costs of $0.05/kWh, consumer tariffs can be applied at $0.20/kWh to meet all parties economic requirements. The rise or fall in generation costs can be more transparently passed through the value chain and reflected in consumer rates. In recent years it appears that Uganda's unbundling has indeed promoted stable pricing for IPPs and preserved creditworthiness of grid operators. In 2012, the government abolished electricity subsidies for consumers and provided a mechanism for retail rates to be regularly adjusted according to changes in exchange rates and fuel prices. In October 2015, for example, Umeme raised tariffs 17 percent to offset drops in the Ugandan Shilling, which had raised the relative cost of fuel imports.[xci] While these policies create volatile pricing for end-users, they allow the Ugandan power sector to stay solvent as it meets its dollar-denominated commitments to contracted power producers. As a result, the national power off-taker, UETCL, is regarded as sufficiently "bankable" to enable long term financing of renewable energy projects. The Ministry of Energy and Mineral Development also can provide a sovereign buyout guarantee in case of UETCL default.

1.2.5 Toward Solar Projects without Subsidies

As with all countries in the region, Uganda needs more grid power. Much of this will come from hydropower capacity, although recent experience shows that excessive hydropower dependence leaves Uganda vulnerable to weather patterns. Solar PV, which performs best in dry periods, is a logical hedge in Uganda, particularly in the sunnier east and north of the country. Currently, two utility projects have been competitively bid at a tariff of a bit above $0.16/kWh. However, the Ugandan government values the solar energy at $0.11/kWh, leaving donors to fill the tariff gap. In order to assure that more utility solar projects are built without the reliance on donor subsidies, the Ugandan government could 1) raise its price for solar energy and/or 2) take steps to reduce development costs. Reforms in utility structure are a positive step, and if Uganda maintains discipline in adjusting consumer rates to reflect utility costs, the costs of capital may decline for projects with UETCL PPAs. Government measures to clarify import duties on solar project hardware, and to facilitate speedy land acquisition for renewable energy projects would also reduce the cost of development.

Uganda Utility-Scale Solar Development Outlook	
Reasons to Build Utility Solar	**Reasons not to Build Utility Solar**
• Diversification from hydropower • No requirement of expensive fuel imports • Low air and noise pollution and GHG emissions • Avoids community and wildlife impact of hydropower • Low wind and geothermal resource makes solar only viable renewable power source • Quick to bring online	• Challenges to integrate in very small grid • Competition from dispatchable hydro, peat and methane plants • Low irradiance in more-populated central and western regions
Attractions for Investors	**Challenges for Investors**
• Solvent off-taker (UETCL) • Sunny east and northern regions • Donor GETFiT tariff subsidies • Rapid growth in power demand	• REFiT tariff too low to support modest sized solar projects • Unclear how many rounds of GETFiT subsidies will be funded • Ambiguity around solar import duties

1.3 Rwanda Utility PV: Utility-Scale Solar Quickly Reaches Capacity on Small Grid

Rwanda is unique in East Africa in that it has already constructed a utility-scale PV project, and it offers lessons to developers and governments seeking to do the same. With the successful completion of the Rwamagana Solar Power Station in Agahozo in July 2014, Rwanda became the first country in Sub-Saharan Africa (except for South Africa) to enjoy a grid connected, MW-scale solar PV project. The project was a triumph for the Rwandan government, foreign development agencies, and its private developers. The project achieved financial close and interconnection within a year of entering into a PPA, an extremely fast timeframe. The 8.5 MW plant immediately boosted the national power capacity by 6 percent and has been operating smoothly in the two years since its completion.[xcii]

With one solar project built and others proposed, the country is grappling with the challenges of introducing meaningful amounts of intermittent power to the grid. Solar developers are now contemplating hybrid and storage-paired systems, which may become the norm in countries seeking to make solar more than 10 percent of their power supply.

1.3.1 Ambitious Government Diversifying from Hydropower

Like Uganda, Rwanda entered the 21st Century heavily dependent on a handful of small hydropower plants and a grid long suffering from lack of investment. A regional drought led to a severe power shortage and sharp load shedding in the 2004-06 period. The government rented expensive diesel generators to bridge supply, which pushed consumer tariffs above $0.20/kWh.[xciii] As of 2014, generating capacity was just 141 MW—57% hydropower and 34% diesel and heavy fuel oil (**Figure 9**.)[xciv] By 2015, the on and off-grid access rate stood at 23%.[xcv] Rwanda consumes a paltry 42 kWh/year/capita compared to the sub-Saharan Africa average of 478 kWh and U.S. average of 13,246 kWh (see **Figure 4** above).[xcvi]

The Government of Rwanda has publicized plans for major grid expansion, which will require large investment in generation and transmission. The government has set a 70 percent electricity access target by 2018, with 48 percent of the population on grid and another 22% utilizing off-grid resources.[xcvii] Transmission is being built to achieve this rapid grid expansion. In 2016 alone, the government expects to add 505 km of medium voltage (MV) lines to an existing network of 4,671 km of MV lines and another 331 km of high voltage (HV) lines to a 423 km network of HV lines.[xcviii] The fast-approaching 2018 generating capacity target is 563 MW, more than tripling the current 141 MW. This figure is ambitious but likely necessary if demand continues to grow swiftly. At 6-7 percent annual GDP growth, Rwanda's economy could double each decade. If the number of inhabitants with grid access also doubles, then electricity requirements could easily quadruple in a very short period.

FIGURE 9: Installed Capacity, 2014 (MW)[xcix]

	Kenya	Uganda	Rwanda	Tanzania
Solar PV	2	-	9	-
Wind	24	-	-	-
Biomass	51	87	-	20
Geothermal	540	-	-	-
Small Hydro	102	67	80	34
Large Hydro	725	630	-	532
Coal	-	-	-	-
Natural Gas	54	-	4	527
Oil & Diesel	697	123	48	495
TOTAL	2,195	907	141	1,608

To meet on-grid power-supply targets, Rwanda is largely relying on hydropower, methane gas, and peat biomass generation. The 28 MW Nyaborongo hydropower station was completed in 2014, and three more run-of-river dams representing over 300 MW are under development by the end of the decade.[c] Methane gas from the volcanic Lake Kivu offers a domestic source of thermal feedstock cheaper than imported diesel. In 2015, the 22 MW methane-powered KivuWatt Power Station, developed by CountourGlobal, came online.[ci] In the same year, Symbion Power was awarded a 50 MW concession for methane power generation. Biomass plants fired by peat, a fuel source found in abundance in East Africa and which emits more CO2 per unit of energy production than coal, may also expand baseload by 100 MW within five years.[cii]

Although it has to compete with hydropower, methane and peat for attention, solar is an important part of Rwanda's on-grid capacity growth strategy. Rwanda is an upland country with moderately high irradiance.[ciii] On-grid solar is attractive to Rwandan energy planners because it can be built relatively quickly. Indeed, one of the most challenging terms of the Rwamagana solar PPA, was the requirement to achieve financial close within six months (plus one month extension) of the signing of the PPA, an ambitious timeline that was ultimately met.[civ] The downside of solar is its intermittency. In Rwanda, peak demand comes in the early evening, after the sun has gone down. Since the country has limited short-term peaking capacity, reliable baseload power sources must be nearly adequate to meet peak evening demands. In an effort to smooth the spike in evening demand, the Rwandan government instituted a phased time-of-use (TOU) rate structure for industrial users, where tariffs are significantly higher after 5pm.[cv] TOU pricing has not been implemented for residential and small commercial customers.[cvi]

1.3.2 Power Market Reforms Lower Risks for IPPs

The Rwandan electricity industry has undergone recent structural reforms similar to unbundling reorganizations undertaken in Uganda and under consideration in Tanzania. Previously, the energy generation, transmission and distribution was integrated under one state organization, first the Rwanda Electricity Corporation (RECO) and more recently the Energy, Water and Sanitation Authority (EWSA). In 2014, the electricity sector was reorganized under the publically owned Rwanda Energy Group (REG) that has two primary subsidiaries. The Energy Utility Corporation Limited (EUCL) runs transmission and existing generating assets, while the Energy Development Corporation Limited (EDCL) is tasked with developing new generating capacity.[cvii] The government is currently considering the separation of the generating and transmission businesses (as has been done in Uganda) within the EUCL to better allow market prices to pass up and down the electricity value chain, and foster utility solvency.[cviii]

To promote the financial viability of the electric utilities the government has phased out consumer electricity subsidies and is committed in principle to passing on true generation costs to transmission providers and true transmission costs to consumers. With limited generation and without consumer subsidies, this has resulted in high tariffs for Rwandan power users. In 2012, retail and low-voltage commercial rates were set at RwF134/kWh ($0.22 at 2012 rates), while high voltage industrial rates had daytime rates of RwF126/kWh ($0.20) and RwF168 ($0.27) evening rates.[cix] Consumer tariffs are set in Rwandan Francs, while IPP generation contracts are typically struck in US dollars. In the summer of 2015, faced with a dollar cost base and a sliding Rwandan Franc (600RwF/$ in 2012 vs. 750RwF/$ in 2015), the EUCL successfully lobbied the Rwanda Utilities Regulatory Agency (RURA), the industry regulatory body, for a 35% rate increase. Retail and low-voltage commercial users now pay RwF 182/kWh ($0.24), while industrial rates were left unchanged with daytime rates at RwF126.[cx] Consumers now pay tariffs that more closely reflect the cost of generation, transmission and distribution.

Though doubtless painful for consumers, these measures seem to be successfully keeping the Rwandan electricity utility economically viable and capable of supporting dollar denominated PPAs with international developers. Since off-taker solvency is a critical factor in the viability of IPPs, this disciplined price policy may ultimately speed the development of new projects displacing expensive diesel and in turn drive down rates.

1.3.4 Developer Speed and Government Ambition Enabled Region's First Major Solar Project to be Built in Rwanda

It is not surprising that Rwanda became the first country in the region to build a utility-scale solar plant. With a technocratic one-party government in a hurry to increase generation and a utility heavily dependent on expensive fuel imports, the authorities moved quickly to enable Gigawatt Global, the Dutch Israel-based solar company, to develop the Rwamagana project.

A number of critical elements came together to make the Rwamagana project succeed.

First, Gigawatt Global was able to obtain secure leasing rights to land quickly and at an attractive price. After evaluating several sites, the developer decided to use land within the Agahozo-Shalom Youth Village (ASYV), a rural educational non-profit founded by American philanthropists. The ASYV is located in the relatively sunny Eastern Province and has engendered favorable community relations in its ten years of operation. The organization had 20 hectares of unused, uninhabited land to lease to Gigawatt Global.[cxi] The ASYV lay 9 km from the nearest substation and the utility agreed to provide the necessary 15kV transmission line to link the solar plant to the grid.

In contrast to land difficulties described by developers in Kenya, Rwandan developers observed that land acquisition is relatively straightforward in Rwanda and that the government owns large tracts available for lease. While the country is densely populated, land can be obtained at a reasonable price.[cxii] While Gigawatt Global was fortunate to have access to surplus land at the ASYV site, other sites were available and considered. Gigawatt complemented its development efforts with pre and post-construction community social responsibility (CSR) activities that have ensured smooth community relations. Periodic plant maintenance employs dozens of local part time workers, who use the site's plant trimmings as free animal feed. All of the plant's full time employees are locals, as are the small onsite contingent of security guards.[cxiii]

Second, the Rwandan authorities were willing to negotiate terms that reduced key project risks and rewarded investors for participating in this pioneering project. At the time that Gigawatt Global began development efforts in 2012, Rwanda did not have tenders issued for solar projects, so Gigawatt approached EWSA, the utility at the time, with an unsolicited development proposal. After submitting a project EOI and signing an MOU with the Government of Rwanda, represented by the Ministry of Infrastructure, Gigawatt Global entered PPA negotiations with EWSA. The negotiations were facilitated by senior officials at the Rwanda Development Board (RDB). Solar PPAs were unprecedented at the time, so Gigawatt Global negotiated a bespoke PPA, rather than working off of an established template. The critical tariff term for the 25-year contract was set in US dollars such that the project would generate mid-teen equity returns.[cxiv] The actual PPA rate remains confidential, though is almost certainly considerably higher than the $0.12 found in Kenya and the $0.163 REFiT/GETFiT found in Uganda, since another Rwandan solar developer, 3E Power, won a tender in late 2013 for $0.215.[cxv] After the price was set, Gigawatt Global negotiated curtailment terms common in solar PPAs around much of the world. The plant uses an onsite pyrometer to calculate deemed power, the basis for utility payment in the event that curtailment occurs.[cxvi] Import duty exemptions were another policy measure, which Gigawatt Global aggressively and successfully negotiated. As in other East African countries, Rwanda officially waives import duties (generally 25%) on solar equipment, without providing full clarity on whether this is defined as solar modules, or also includes less specialized hardware such as wires, inverters, racks and rotators. In contrast to some East African solar developers who negotiated import tariffs at a later stage, Gigawatt Global insisted on an inclusive import exemption very early in the negotiation process.[cxvii]

Third, Gigawatt Global was successful in Rwanda because it acted exceptionally quickly. Speed is important in any project development, but it is particularly important in developing large solar projects. Because solar PV projects only generate power during the day, a new PV project produces a "bump" in the power supply curve. In some geographies, such as those with a prevalence of daytime air-conditioning, the bump in solar generation roughly corresponds to demand. However, in many locations, including East Africa, peak demand occurs in the early evening, after the sun has set and PVs stop producing power. A solar-dependent grid will see a decline in generation just as power is needed most, forcing the utility to ramp up dispatchable power sources, often expensive diesel or heavy fuel oil thermal facilities in East Africa. This problem—solar energy produced when it is least needed and the need for expensive peaker capacity to balance the grid—is compounded as more solar plants are added to the network. Small grids, such as the 180 MW Rwandan system can become overwhelmed with solar capacity after just a handful of projects. To Rwanda, the first solar project was far more valuable than subsequent projects.

With this in mind, Gigawatt Global moved extraordinarily quickly to be first in Rwanda and finance and build the Rwamagana plant. The company signed a PPA with EWSA (the Rwandan utility at the time) in July 2013, and achieved financial close in February 2014. The company was contractually obligated to complete construction within six months and met this target, achieving interconnection in July 2014, and full production in September. To achieve such rapid milestones, Gigawatt Global put a premium on partners and investors with the flexibility, experience and trust needed to move quickly. Lead contractor Scatec (and O&M provider) and sub-contractor Remote Group were selected for their ability to execute within the challenging six-month timeline. Debt investors FMO and EAIF had prior joint experience in Rwanda and closed on Rwamagana in an unprecedented three months. Norfund stepped in with mezzanine debt and equity in a similarly compressed timeframe. KLP, Norway's largest pension fund, invested via a JV with Norfund, a notable and rare example of a pension fund investing directly in an African energy project. Scatec also contributed equity in the project. Grants from the Energy and Environment Partnership (EEP) and the U.S.-Africa Clean Energy Finance Initiative (ACEF) facilitated project development. Gigawatt Global received critical legal support from the law firm Norton Rose Fulbright. [cxviii] The Rwandan government played a constructive role, fast tracking construction permits and completing the required 9km transmission spur.

1.3.5 After Gigawatt's Success, Solar Integration Question Hangs Over Additional Projects

The value of Gigawatt Global's rapid development and first mover advantage become apparent when considering the 10 MW second place solar PV project pursued by Goldsol, a development consortium which included South Africa-based TMM Renewables, Portugal-based Gesto Energy and Rwanda's 3E Power. The development effort began in 2013, a year after Gigawatt Global began pursuing the Rwamagana project. Goldsol got off to a promising start. The project was sited on uninhabited government-owned land in the relatively sunny Eastern Province, and, like Gigawatt Global, Goldsol negotiated an import tax exemption on all equipment. Goldsol won a competitive tender among six international bids in December 2013 at $0.215/kWh price point, and in June 2014 signed a Memorandum of Agreement (MoA) with the government to conduct a feasibility study and to negotiate the PPA.[cxix]

In 2014, however, the Rwandan power sector underwent reorganization, with the EWSA privatized and reorganized into the Rwanda Energy Group (REG), and changes of senior staff. Under pressure from a steadily weakening Rwandan Franc and armed with a mandate to make the Rwandan utilities financially sustainable, in 2015, REG placed multiple generation contracts under review, including the Goldsol agreement.[cxx] By then, Rwanda had 8.5 MW of solar capacity on a 180 MW grid and closely evaluated the marginal value of Goldsol's additional 10 MW of intermittent daytime power production for the system. Government officials also observed solar hardware costs continuing to fall and calculated that projects could now be financed at lower FiT rates.[cxxi] The project was renegotiated at significant tariff reduction and the developer aimed to complete renegotiations by late 2016.

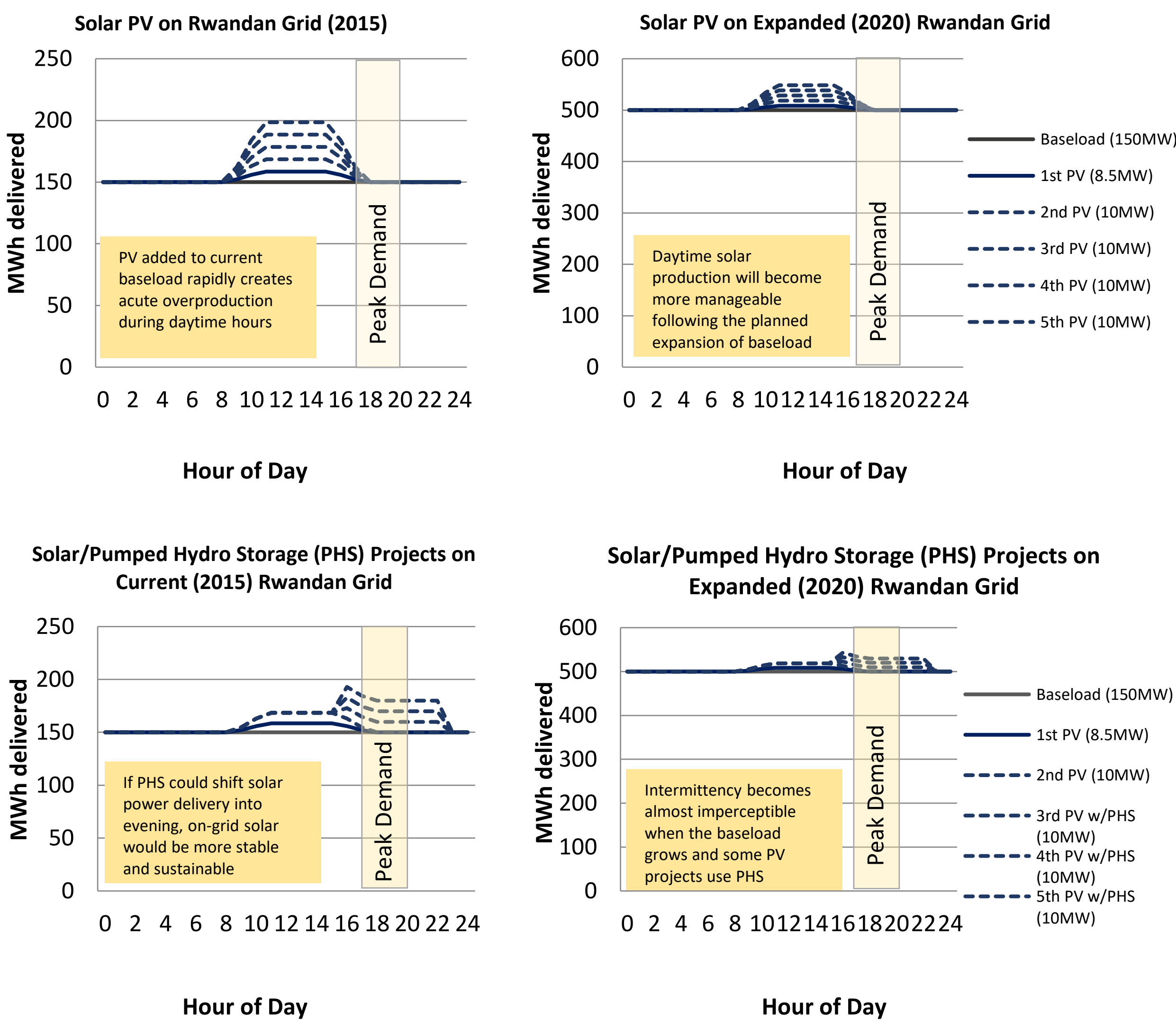
Other developers have been challenged by bureaucratic reorganizations in Kigali, the Rwanda capital. Local developer Kivu Solar attempted to negotiate an unsolicited solar PPA in 2013 (as Gigawatt Global did). They were then shepherded into a 2014 tender process (won by Goldsol). Today there is no further tender and in theory developers are able to present unsolicited proposals, but the lack of policy clarity and stability has discouraged the group from pursuing further solar projects in Rwanda.[cxxii]

Ministerial shuffles and process uncertainty, however, are surmountable challenges for on-grid solar PV development. At the moment, the more fundamental challenge is the ability of the current grid to absorb much more intermittent, daytime power.

As **Figure 10** illustrates, solar creates an afternoon spike in generation that does not correspond to peak generation. The more solar capacity that comes online, the more pronounced the supply-demand imbalance becomes. If the Goldsol project was to come online on the current grid, the country would have a grid capacity comprised of over 10 percent solar PV, mostly delivered during non-peak demand periods.[cxxiii] For this reason, Goldsol's developer thinks that the project will be the last pure-play PV development in Rwanda for six to seven years, the time required for the grid to develop demand for afternoon generation.[cxxiv]

FIGURE 10: Rwanda Grid Simulations - Hourly

Analysis of Rwanda's hourly generation capacity with the additon of up to five Solar PV and/or Solar PV with Pumped Hydro Storage (PHS) projects.



1.3.6 An African Testing Ground for Solar Paired with Storage?

To overcome natural limits to solar PV on the current Rwandan grid, developers are now looking at pairing solar with economical forms of storage to shift power delivery to peak demand periods in the evening. Since Rwanda would pay $0.35-0.45 /kWh for the backup diesel of heavy fuel oil (HFO) required to smooth out solar-spiked capacity curves, there should in theory be appetite to commission storage at attractive commercial rates.[cxxv] French renewable energy developer CDN is pursuing a PV project paired with pumped hydro storage (PHS). This technology is a logical choice for Rwanda, which is generally hilly, enjoys access to large and small lakes, and already has hydropower stations in a few locations. At the moment, however, Rwanda's rate structures do not support a PHS solution. To date, Rwanda has treated solar power as a premium, high-priced power source, while pricing hydropower as a lower-cost baseload source. For PHS to be economical, however, rates would need to be set to discourage daytime dispatch of solar PV and encourage early evening dispatch of pumped hydropower. For example a solar-PHS power provider earning $0.13/kWh on solar energy and $0.20/kWh on hydropower energy during a peak demand period would be incentivized to use solar power to pump water during the day.[cxxvi] Similarly creative rate structuring will be required to make battery storage an economic solution to solar integration in Rwanda.

If Rwanda can achieve solar storage solutions, it will become an encouraging case study not just for Africa, but for countries all around the world grappling with solar intermittency.

Rwanda Utility-Scale Solar Development Outlook	
Reasons to Build Utility Solar	**Reasons <u>not</u> to Build Utility Solar**
• Diversification from hydropower • Does not require expensive feedstock supply • Low air and noise pollution and GHG emissions • Quick to bring online	• Challenges to integrate in very small grid • Competition from dispatchable hydro, peat and methane plants
Attractions for Investors	**Challenges for Investors**
• Healthy solar resource in east of country • Relatively high solar FiT • Land availability • Stable, technocratic government • Rapid growth in power demand • Market reforms strengthening utility off-taker credit quality	• Bureaucratic flux and changes to energy procurement process • Recent precedent of renegotiated solar contracts • Ambiguity around solar import duties

1.4 Tanzania: Niche Opportunities in a Challenging Power Investment Climate

In East Africa, improving creditworthiness of national utilities has been a major enabler of the development of utility-scale solar projects. Unfortunately, Tanzania has fallen behind the region in power sector reform and its utility, the Tanzania Electric Supply Company Limited (TANESCO) is poorly managed and mired in debt. While there are many challenges to energy development in Tanzania, the difficulty financing projects on the back of a TANESCO PPA may be the single biggest factor preventing utility-scale solar deployment.

1.4.1 Lack of Power Sector Reform Impedes Solar IPPs

Tanzania should be a prime destination for power investors. It is a large country with a dispersed population of 47 million. Like other countries in the region, it has extremely low levels of electrification, with just 18% of the population having access to electricity in 2013. Total generation capacity is just 1,500 MW, barely half of neighboring Kenya that has a similar population. Retail energy prices are high, averaging $0.17/kWh.[cxxvii]

Demand for power is growing at 10-15% per year and the government has ambitious plans to expand on-grid capacity. President Kikwete's "Big Results Now" initiative, announced in 2013, aimed to raise generating capacity to 2,780 MW by 2016 both by developing new natural gas resources in the southern region and by replacing expensive and dirty diesel generators currently used to supply remote areas. Tanzania differs from other East African countries in that it has major gas reserves in its southern coastal region. This gas is being piped to generation facilities in and near the major load centers. This means that the most important part of Tanzania's grid is increasingly served by a power source that is relatively economical and has lower emissions than thermal generation from coal or petroleum products.

FIGURE 11: Installed Capacity, 2014 (MW)[cxxviii]

	Kenya	Uganda	Rwanda	**Tanzania**
Solar PV	2	-	9	**-**
Wind	24	-	-	**-**
Biomass	51	87	-	**20**
Geothermal	540	-	-	**-**
Small Hydro	102	67	80	**34**
Large Hydro	725	630	-	**532**
Coal	-	-	-	**-**
Natural Gas	54	-	4	**527**
Oil & Diesel	697	123	48	**495***
TOTAL	2,195	907	141	**1,608**

**67 MW of total oil and diesel generation is off-grid*[cxxix]

Tanzania's efforts to develop its power sector have consistently been hampered by political problems. The $1.2 billion China-funded gas pipeline to the population center of Dar-es-Salaam was delayed by riots in Mtwara, near where the gas originates.[cxxx] The project was ultimately completed in 2015 and should allow coastal Tanzania to replace some expensive heavy fuel oil (HFO) thermal generation with more economical natural gas.[cxxxi] Political considerations also affect pricing and distribution decisions. To assuage its separatist sentiments, the island of Zanzibar receives power at a relatively low wholesale rate, much to the ire of mainland Tanzanians.[cxxxii]

Tanzania is an especially challenging geography for IPP investors due to the poor credit-worthiness of TANESCO, the state utility off-taker. TANESCO has long suffered from a lack of political independence and from corruption, which have eroded the company's balance sheet. The company is thought to hold debts of at least $250 million and has sought loans and grants from DFIs to restructure these debts.[cxxxiii] The vertically integrated structure of TANESCO has also contributed to rising debt at TANESCO. Unlike neighboring Kenya, Uganda and Rwanda, Tanzania has not yet separated its generation, transmission and distribution businesses. This makes it more difficult for each TANESCO service to be competitively priced and for retail rates to allow the upstream businesses to achieve full cost recovery. While the Energy and Water Utilities Regulatory Agency (EWURA), can adjust tariffs, as it did when it allowed TANESCO to raise rates 39% in January 2014, TANESCO'S vertically integrated structure is seen as a major cause of its indebtedness.[cxxxiv]

There have been discussions of breaking up TANESCO for many years and many hope that the November 2015 presidential election of reform-minded John Magufuli will make these changes a reality. The current power sector reform roadmap recommends dividing TANESCO into generation, transmission and distribution companies, with the possibility of privatizing the generation and distribution units.[cxxxv] It is hoped that the new structure would include a "cleaned up" transmission company, able to provide investors with a more credit-worthy off-taker.

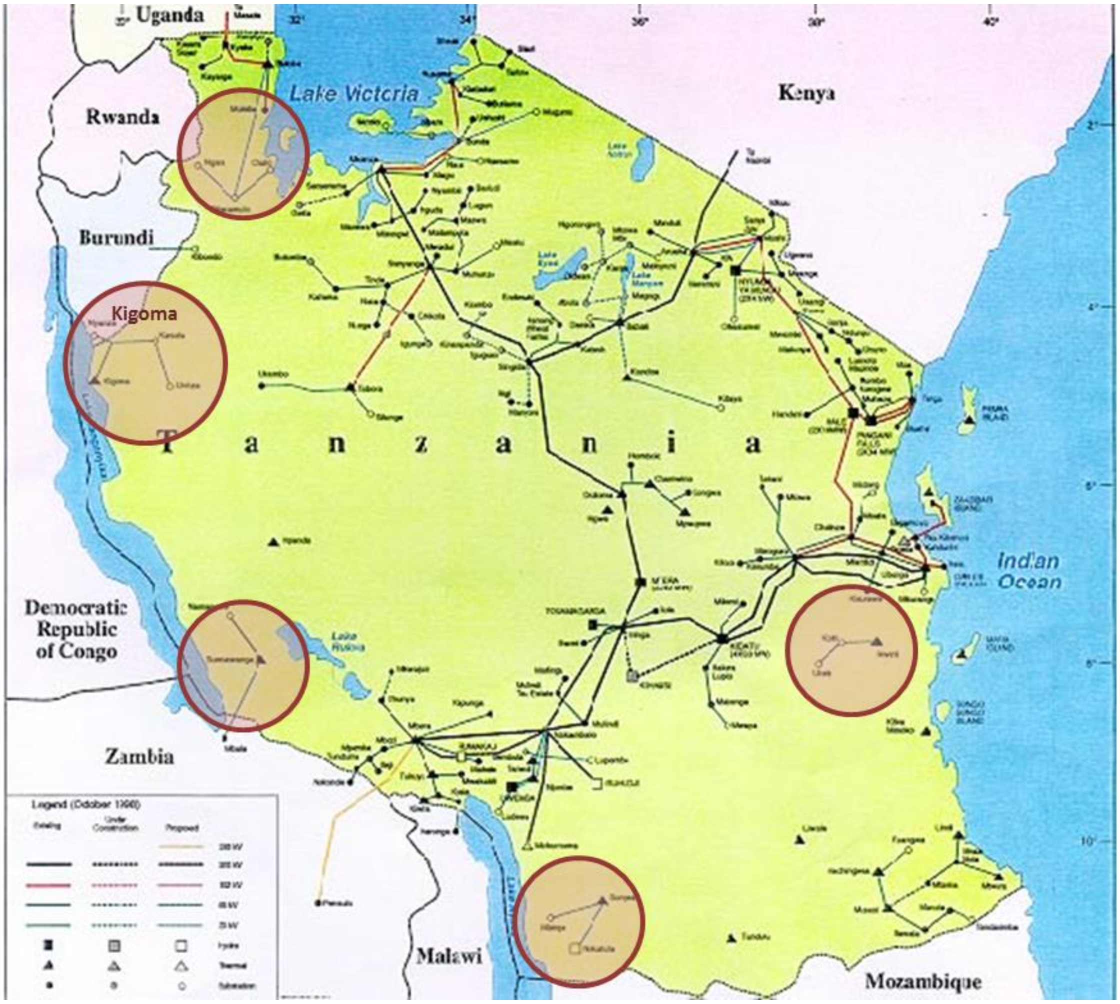
Until TANESCO is reformed, IPPs can attempt to achieve credit enhancements by obtaining sovereign guarantees from the Government of Tanzania. However, current legislation only permits sovereign guarantees for projects majority owned by the Tanzanian state.[cxxxvi] Even if this particular regulation is relaxed, the government is hoping to earn a rating for sovereign debt issuance and is justifiably wary of loading up its own balance sheet with TANESCO-contracted project liabilities.[cxxxvii] In the absence of power sector reform or sovereign guarantees, IPPs may require equity returns of 20-30 percent, a very high bar for power projects.[cxxxviii]

In this policy and regulatory environment, large solar projects do not make sense for the core part of Tanzania's power consumption – the heavily populated Swahili coast areas containing Dar-es-Salaam, Tanga and Zanzibar. With the completion of the southern gas pipeline, the region now enjoys economical feedstock for thermal generation and cannot easily justify solar feed-in-tariffs high enough to entice developers and investors to brave TANESCO contracts.[cxxxix]

1.4.2 Solar Potential in Utility-Serviced "Island Grids"

Instead, the opportunities for megawatt-scale solar projects lie in the more remote regions of this very large and demographically scattered country. Tanzania contains 19 "island grids", on-grid areas that are not connected to the main national grid (**Figure 12**). These island grids are served by 81 MW of diesel-fueled capacity.[cxl] Due to high transport costs of fuel, diesel generation costs are very high, typically between $0.30-$0.40/kWh.

FIGURE 12: Select Island Grids in Tanzania



In these island grid environments, solar projects are better justified, as power delivered directly offsets diesel generators, which can be dispatched and curtailed quickly, like peaker plants. The country's first large solar plant is being developed in Kigoma, an isolated Western city served by an island grid. The 5 MW PV plant is being developed in two phases by NextGen Solar, which leased 25 acres of land from the Tanzanian Government in the Kigoma Special Economic Zone.[cxli] The PPA was signed with TANESCO in January 2013 for an undisclosed rate and the US government provided advisory support on the PPA document under the aegis of the Power Africa Initiative.[cxlii] At the time, TANESCO was offering FiTs on small (<10 MW projects) on an "avoided" cost basis, suggesting that NextGen may have secured a FiT as high as $0.30/kWh. Over the past two years, however, Tanzania has moved to a "2^{nd} Generation" model with fixed FiTs depending on technology. Unfortunately, only biomass and hydropower were given fixed tariffs. A model PPA was also put in place, but not for solar, leading to some policy ambiguity that will hopefully be addressed by the new Magufuli government.[cxliii] Despite these challenges, the attractive economics of displacing expensive diesel generation with solar remain unchanged in the 81 MW island grid market.

1.4.3 Working Through Off-taker Challenges in Dodoma

At least one developer is pursuing larger and more ambitious solar projects in other parts of the country. Hecate Energy, an American solar developer, is in negotiations with the Tanzanian government to undertake a 55 MW solar project in Dodoma, the Tanzanian capital city located in the sunny central highlands. Dodoma is only thinly connected to Tanzania's coastal grid, which is mainly supplied by hydropower and gas thermal plants. As such, Hecate believes that Dodoma is isolated enough from other generation sources to make utility solar attractive. The project would involve on-grid power generation with 2 MW dedicated to distributed, off-grid generation. In order to overcome the TANESCO counterparty challenges, the company is assessing innovative political risk insurance schemes as an alternative to sovereign guarantees.[cxliv] If the Dodoma project succeeds, it would demonstrate the viability of large (>10 MW) solar projects in East Africa as well and show that solar developers can work around the weak off-takers.

Tanzania Utility-Scale Solar Development Outlook	
Reasons to Build Utility Solar	**Reasons not to Build Utility Solar**
• Diversification from hydropower • Does not require expensive feedstock supply • Low air and noise pollution and GHG emissions • Numerous "island" grids solely served by expensive diesel • Quick to bring online	• Cheap natural gas is now available in populated eastern seaboard • Competition from dispatchable hydro, peat and methane plants
Attractions for Investors	**Challenges for Investors**
• High retail power prices • High irradiance, especially inland • Rapid growth in power demand	• Poor credit quality of utility off-taker • Mismanaged power sector and slow reform timelines

1.5 Financing Utility-Scale Solar Projects in East Africa

Africa is widely considered to be a capital-constrained continent. In 2010, the World Bank and the *Agence Francaise de Developpement* (AFD) estimated that sub-Saharan Africa required $93 billion of infrastructure investment annually, more than double the $45 billion estimated to have been spent that year.[cxlv] In 2014, fixed asset investment as a percent of GDP was just 19.6 percent in Kenya, far lower than the 47.7 percent in China and 32.2 percent in India.[cxlvi]

Despite the overall deficiency in infrastructure investment, the developers of utility-scale solar projects do not generally lack for capital. While local debt remains far too expensive to play much of a role in solar projects, there are currently ample sources of international equity, debt, and grant funds to execute quality solar projects in East Africa. Instead, a common view among investors is that there is too much capital chasing too few legitimate and bankable solar projects. The following is a snapshot of the financing landscape for large solar projects in East Africa in the middle of this decade.

1.5.1 Local Bank Debt Inadequate for Solar Project Finance

Local bank loans are not yet a suitable source of project finance for East African solar projects. Banks remain risk averse and often make much of their profits from fees and cash management services rather than lending.[cxlvii] The results are commercial rates of 20 percent or more in Kenya. Uganda can be even higher at 29-32 percent, while Rwandan bank rates are dropping and now stand at 15-17 percent.[cxlviii] Debt tenors are short by international standards, rarely exceeding five years, and rates are usually variable.[cxlix] Moreover, non-recourse project loans, where the lender is entitled to repayment only from the project profits but has no recourse to the assets of the borrower, are uncommon in local debt markets. Name lending, or providing credit on the back of personal or family reputation rather than company balance sheets, is widely practiced. A strong sponsor can sometimes finance projects with 100 percent debt but would be personally liable for repayment if a project underperforms.[cl] In short, local bank debt rates and terms are currently unsuited to solar project finance, which typically requires non-recourse and low cost debt, matching the long time horizon of the PPAs and boosting returns on a small tranche of risky equity financing.

1.5.2 Development Finance Institutions Fill the Void for Now

International Development Finance Institutions (DFIs) have stepped in to remediate this shortfall and for the moment there appears to be sufficient debt capital for large solar projects. The World Bank Group's International Finance Corporation (IFC) lends dollars at non-concessional rates of 7-8 percent, typically at 15 years, but occasionally pushes tenors to 17 or 18 years, and targets coverage ratios of 1.2-1.3x.[cli] The Netherlands Development Finance Company (FMO), German Investment Corporation (DEG) and the Japan International Cooperation Agency (JAICA) are known to lend in the 6-7 percent range, while the Overseas Private Investment Corporation (OPIC) has come in at under 5% and Norfund is also "highly concessional", according to industry sources.[clii] USAID, the French Development Agency (AFD) and Germany's KfW agency also offer concessional projects financing, but typically fund smaller pilot projects and those with an explicit social mission.[cliii] For example the AFD provided 100 percent debt finance at just 4.1% to the 600 KW solar project at Nairobi's Strathmore University, a social enterprise dedicated to business education.[cliv]

DFI funding was critical for the success of the Rwanda solar project. In Rwanda, Gigawatt Global secured 75 percent debt financing from FMO and the London-based Emerging Africa Infrastructure Fund (itself largely funded by the KfW and FMO), and an additional 10 percent of mezzanine financing from Norfund.[clv]

The DFIs are beginning to encourage local banks to administer the financing of solar and other energy projects. In Kenya, AFD has made a concessional debt facility available to Chase Bank and Co-op Bank, two of the country's largest private lenders. The banks are charged a flat fee to use the facility and appear to be motivated to deploy capital on smaller projects. By the end of 2015, Chase Bank had a $75 million credit line and a pipeline of $150 million of solar, hydro and biomass projects.[clvi]

Direct grants also improve project economics, particularly for project sponsors injecting early stage risk capital. Gigawatt Global obtained EUR 245,000 from the Energy and Environment Partnership (EEP) and $400,000 from OPIC to support early development efforts in Rwanda.[clvii] Kenergy has obtained a $900,000 OPIC grant to deploy toward early development work on its 40 MW project in Kenya.[clviii] While these grants are less than 3% of total project costs, they have a huge impact on the returns of project sponsors, many of whom are small and thinly capitalized firms.

Without these types of DFI funding sources, large solar projects would not be viable in East Africa. For the time being, there appears to be ample solar project funding appetite from the DFIs, who cannot find enough quality solar projects to invest in. There are many structural challenges to overcome before utility-scale solar projects will proliferate beyond the funding capacity of the DFIs. Until then, the sector is unlikely to be capital constrained.

1.5.3 Financing Matters, but is No Substitute for Project Fundamentals

Figure 13 assesses the impact of debt terms on the viability of a "typical" utility-scale solar project in East Africa. Not surprisingly, project economics are highly sensitive to debt terms. A project with 83% debt financing may have 4 percent higher equity return than a project with 75 percent debt. Increasing the interest rate by just 70 basis points can take two points off equity returns. Similarly, a 17-year amortizing loan can add at least a point to returns over a 15-year loan. Clearly, debt terms are critical to East African solar deals and the continued flow of DFI funds will be important for some time.

On the other hand, equity IRRs are more sensitive to project fundamentals than to debt terms. A decline of system costs from $2.50/W to $2.25/W can add 7 percent to returns. Achieving a comparable return boost through debt would require dropping interest rates by 300 basis points or extending loan tenors to 30 years. Similarly, a 10 percent increase in the solar FiT can have more impact than reducing interest rates by 200 basis points.

While project financing terms are important, there is no substitute for project fundamentals—building projects in sunny places where governments value the power enough to pay an adequate tariff for it, and obtaining the most competitive EPC contracts.

FIGURE 13: Simulated Project Financials and Sensitivity to Debt Terms

Project Assumptions			
System Size		20	*MW*
System Cost	$	2.50	*$/W*
Capex	$	50,000,000	
Local Irradiance		6	*hrs/day*
Construction Time		6	*months*
Annual degredation		0.5%	
PPA Rate		$0.14	*$/kWh (no escalation)*
Annual Opex		10%	*% of revenue*

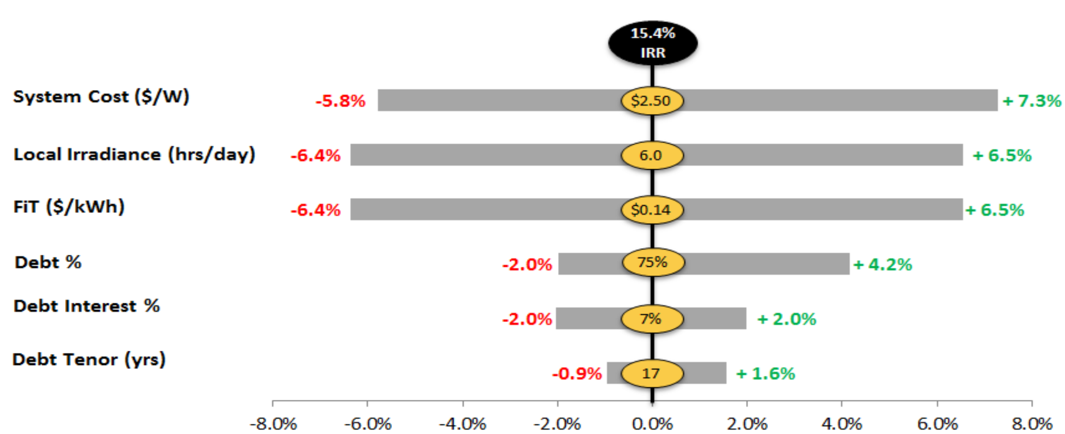
Financing Assumptions		**Ammount**	**% of Project**
Equity	$	12,500,000	25%
Debt	$	37,500,000	75%
Interest		7%	*Fully ammortizing*
Debt tenor		17	*years*

To simulate the equity IRR impact of debt financing terms, we examine a hypothetical 20 MW project enjoying "base" conditions found in East Africa today. Construction costs are $2.50/W, local irradiance is 6 hrs/day and the FiT is $0.14, on the lower end of regional rates. The project is financed with 75% debt with 7% interest and a 17- year tenor. This project produces a 15.4% return for equity investors.

Project Financials	**Y1**	**Y2**	**...**	**Y15**	**...**	**Y20**
Energy Generated (MWh)	21,900	43,581		40,832		39,821
Revenue	3,066,000	6,101,340		5,716,435		5,574,946
Opex	306,600	610,134		571,644		557,495
Net Revenue	2,759,400	5,491,206	...	5,144,792	...	5,017,452
Debt Service	-	(3,840,945)		(3,840,945)		-
DSCR		*1.43x*		*1.34x*		-
Free Cash to Equity (FCFE)	2,759,400	1,650,261		1,303,847		5,017,452
Equity Capex	$ (12,500,000)		...		...	
Net Cash	(9,740,600)	1,650,261		1,303,847		5,017,452

IRR	15.4%

Equity IRR Sensitivity to 10% Change in Inputs



Equity investment is generally available for solar projects in East Africa, albeit at a higher cost than found in most other markets. Kenyan projects target at least 16 percent equity returns, though this may slip due to project delays and land acquisition complexities.[clix] Ugandan solar developers sought 22 percent equity returns, though these expectations have more recently slipped into the high teens.[clx] In Tanzania, TANESCO's perceived payment risk pushes return expectations as high as 30 percent, a severe challenge to projects.[clxi] By contrast, sponsor equity returns for US solar projects are often in the high single digits. Return expectations in East Africa are high due to perceived political risk – future governments might seek to renegotiate PPAs, or national utilities might stop contracted payments. Political risk insurance is an option but premiums are high.

There are numerous investors attracted to the robust returns and positive developmental impact of African solar projects. In addition to DFIs, private players such as Switzerland-based responsAbility AG and the UK's Berkeley Energy both have African energy funds in the market to fund solar projects.[clxii] These investors see quality projects, rather than capital as the main limiting factor in utility-scale solar in East Africa. A representative of Berkeley Energy observed that while there are many solar projects being proposed, the number of "investable" projects is actually extremely limited.[clxiii] Due to the dearth of "shovel-ready" solar investment opportunities, some investors are inserting themselves upstream in the development process to guide "project preparation".[clxiv] One such entity is the IFC's InfraVentures, launched in 2012 to fund up to 50% of sponsor development costs in African infrastructure.[clxv] GreenMax Capital Advisors, once specialized in helping investors assess European renewable energy projects is now increasingly working in Africa advising developers on how to make their project "bankable". These developments are symptoms of a market where capital is available but quality projects are scarce. If governments take measures to make solar project development more attractive and less risky, and if project costs continue to fall, it appears that financing will be available for East African PV projects.

SECTION 2: Commercial & Industrial Scale PV Projects: A More Sustainable Model for East Africa?

As we have seen, land acquisition challenges, lengthy government approvals, and insolvent state off-takers are some of the major hurdles to building utility-scale solar projects in East Africa. In some countries, generous FiTs are enough to compensate for these challenges, while in Kenya, the solar FiT is not high enough to tempt any but the most adventurous developers.

2.1 High Commercial On-Grid Tariffs Make C&I Solar Attractive in Some Geographies

While utility-contracted solar projects will continue to play a role in the powering of East Africa, many African energy entrepreneurs are beginning to tout the potential of commercial and industrial ("C&I") projects as the future of solar in the region. C&I projects power large enterprises, typically commercial buildings such as shopping centers, office parks, or industrial facilities such as factories, mines, and agribusinesses. Residential facilities such as apartment buildings and hotels are also potential solar customers. C&I customers can be divided into on-grid and off-grid use cases.

2.1.1 On-Grid C&I

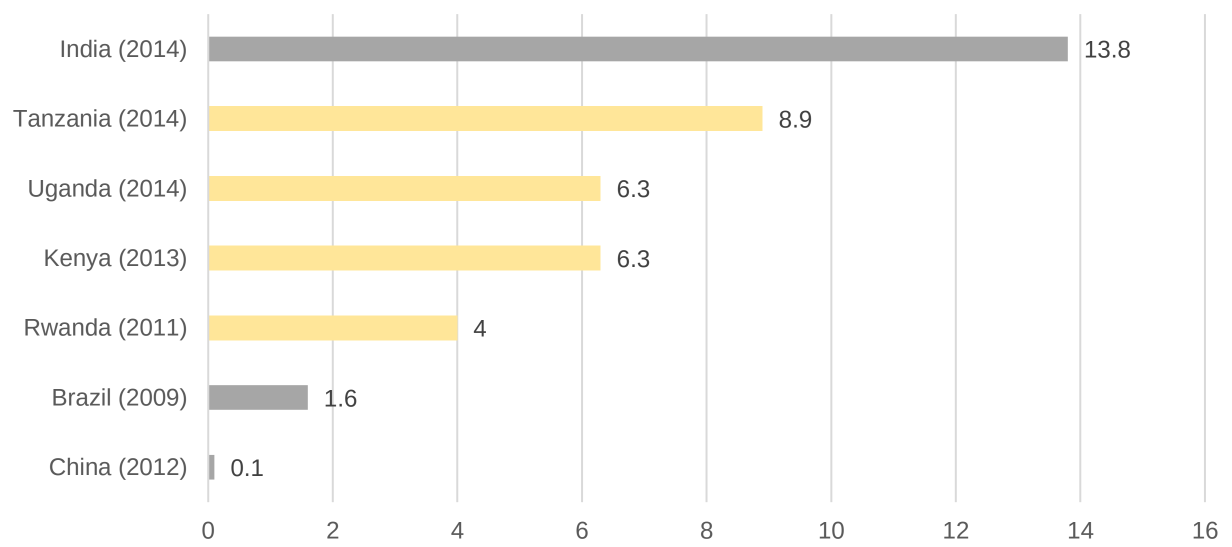
The universe of potential C&I customers is quite large. In Kenya, for example, 80% of on-grid power goes to 5,000 major customers.[clxvi] On average, each of these power users represents about 400kW of capacity, large enough to be attractive for C&I developers.

The business case for building on-site solar plants at businesses in East Africa is compelling because solar offsets relatively high commercial power tariffs. Kenyan on-grid businesses pay between $0.12 and $0.15 per kWh of power (**Figure 14**). In Uganda, commercial and industrial tariffs exceed $0.16.[clxvii] By comparison, average on-grid power prices in China and India, are $0.11 and $0.12 respectively.[clxviii] In addition, even on-grid customers suffer from frequent power interruptions in East Africa (**Figure 13**). These businesses often deploy backup generators during outage periods. Since generators run on expensive diesel fuel ($0.30-0.40/kWh of generation), power bills often exceed the businesses utility tariffs.

FIGURE 14: Kenya & Uganda Power Tariffs, April 2016 (US$ cents/kWh)[clxix]

Kenya	Consumption	Other Charges	**Total**
Domestic	12.6	6.9	**19.5**
Small Commercial	13.4	7.0	**20.4**
Commercial 1 (415 V)	9.1	6.1	**15.2**
Commercial 2 (11 kV)	7.9	5.9	**13.8**
Commercial 3 (33 kV)	7.4	5.8	**13.2**
Commercial 4 (66 kV)	7.2	5.7	**12.9**
Commercial 5 (132 kV)	7.0	5.7	**12.7**
Uganda			
Domestic	19.7	(0.3)	**19.4**
Commercial	17.8	(0.3)	**17.5**
Medium Industrial (415 V)	16.5	(0.3)	**16.2**
Large Industrial (up to 33kV)	11.2	(0.3)	**10.9**

FIGURE 15: Number of Monthly Power Outages for Businesses[clxx]



Matt Tilleard, Managing Partner of CrossBoundary, a Nairobi-based investment and development firm dedicated to C&I solar projects, describes the most economical on-grid customer profile. An ideal customer will aim to offset 20-30 percent of its high-cost grid power consumption. Customers with seven-day loads are more economical than weekday businesses, where two-sevenths of generation would be wasted. These early adopter customers expect 30-40% savings on solar energy compared to grid electricity versus the 10-15 percent savings commonly offered for US rooftop solar.[clxxi] As time goes on, however, Kenyan customers may start to accept slimmer savings, as solar PPAs become more common and perceived as less novel or risky.

2.1.2 Off-Grid C&I

Some remote businesses, such as mines or nature lodges, may be off-grid businesses and rely wholly on expensive diesel power for any electricity consumed. In Kenya, approximately 25% of power is produced by diesel generators.[clxxii] Solar installation allows these customers to turn off part or all of their diesel generation whenever the sun is shining. Solar usually would not displace diesel generation entirely, because there are gaps in generation at night and during cloudy periods. In theory, solar energy can be stored with batteries and dispatched during gap periods but the high cost of battery capacity currently makes these solutions prohibited. For the time being, off-grid C&I solar is a part-time diesel displacement business, not diesel replacement.

2.2 Less Regulation and Net Metering is a Nice-to-Have

Regulation of C&I solar projects is very thin in East Africa, which is one of the attractions for investors. Instead of lengthy approvals and contract negotiations with national and regional authorities, solar developers negotiate directly with business owners. In Uganda, solar projects up to 500 kW do not require permits.[clxxiii] On the flipside, the lack of distributed generation regulation means that on-grid C&I customers do not generally enjoy the economics of net metering. In 2011, Germany's GIZ issued a report recommending that Kenya implement a net metering program, but it has not been adopted.[clxxiv] But one C&I solar entrepreneur noted that there are ample projects "in the money" without net metering and that for the time being he would prefer to be "left alone" by the Kenyan government rather than being dependent on advantageous policies such as net metering.[clxxv] Another Kenyan solar investor observes that while a 2012 ERC regulation theoretically allows businesses to sell excess power to third parties, most C&I solar customers currently aim to size their systems such that they do not produce major surpluses.[clxxvi]

The 600 kW Strathmore project is a pioneering solar project that demonstrates the viability of the on-grid C&I solar model. Strathmore University is a prestigious non-profit professional school in Nairobi, with approximately 5,000 students. The 600kW rooftop solar project was commissioned in 2014 with the technical assistance of GIZ, and constructed at a cost of $1.3 million. The project was originally designed to offset 60% of the university's peak load, but now supplies just 40% due to university expansion. AFD provided 100% debt financing at the concessional rate of 4.1 percent, allowing for a 10-year payback. At a relatively modest 5.1 hours of sun, the project has met output targets and is considered an economical success story. [clxxvii] Moreover, after several years of legal work, Strathmore won the right to sell excess power back to the grid, i.e. net metering, which has lowered the project payback from ten to seven years.[clxxviii] The Strathmore net-metered solar PPA, however, is seen as a unique and fortuitous bilateral contract, unlikely to be granted to other distributed C&I solar customers. Thus another Kenyan C&I solar project, the 858 kW solar carport at Nairobi's Garden City Mall, completed in September 2015, will not likely net meter.[clxxix]

2.3 Utility Backlash is Possible but Unlikely in the Near Term

As in many international jurisdictions, developers worry about the long-term potential for punitive regulation of on-grid distributed solar generation. If many East African businesses began offsetting their daytime electricity consumption with self-generated solar power, the grid might start to develop overcapacity in the daytime and require rapid ramp-up in the early evening, when solar generation declines just as consumers demand peak early-evening loads. . Governments might respond by imposing fixed capacity charges on distributed solar or even banning new projects. For the time being, however, these fears may be premature. Kenya currently has 2 MW or less of C&I solar, a trivial figure. One energy investor thinks that C&I solar won't draw the attention of the Kenyan government until at least 50 MW (i.e. scores of projects) are constructed.[clxxx]

2.4 PV with Storage Has Potential but Diesel Generators Aren't Going Anywhere

Energy storage may be paired with some C&I PV projects but only in niche situations. Across Africa, businesses usually rely on onsite diesel generators for backup power, if they're on an unreliable grid, or for on-site generation, if they are off-grid. Diesel generators are relatively inexpensive to acquire, but quite expensive to run. Battery systems, by contrast, are currently expensive to acquire (though prices are falling and system are lasting longer) but cheap to operate.

In on-grid situations, the economics of commercial battery storage paired with PV are challenging because the up-front cost of battery capacity is very high. A small, high-cycle life battery could fill in for short-term interruptions in solar generation (for example when a cloud briefly passes over the sun), but there would be little economic benefit. On-grid solar merely displaces grid-electricity consumption. At $0.12-$0.16/kWh, East Africa's grid electricity is not expensive enough to justify the use of battery-stored solar power over grid power.

The economics of battery storage is more favorable compared to diesel-generated power, which is much more expensive than grid-electricity tariffs in East Africa. Supposing a business faced ten 20-minute grid outages per month, a relatively small, inexpensive battery could eliminate the need for diesel backup generation hardware and generation. The challenge is that power outages are by nature unpredictable. The business might in fact have nine 20-minute outages and one 12-hour outage. A battery able to cover a 12-hour outage would be prohibitively expensive, so the customer would likely keep a generator to cover the longer outages.

Similar dynamics exist for off-grid PV businesses expecting uninterrupted power. Batteries could indeed "smooth" PV production during cloudy days or shift some production to nighttime use. But PV systems are even more unpredictable than grid-power. In a period, the grid electricity might go down for half a day. In a bad period, such as the rainy season, a PV array could go a whole week without full sun. Such a customer would need a battery able to store a whole week of their energy need. This system would be extremely large and expensive. The economics remain better for diesel generators, which are better suited to these long outages as long as the business has sufficient supply of diesel fuel. At the moment there may be a few niche businesses willing to incur the high upfront expense of batteries for power backup. These include businesses that require extremely fast power recovery (such as mines which use expensive uninterruptable ore processing equipment) or high-end game lodges averse to the noise pollution of diesel generators.[clxxxi]

Innovations around system integration may bring storage into the C&I solar picture. Automatiks, a California-based energy startup, has developed an integrated solar + battery + diesel system for off-grid uses. The system uses battery charging and discharges to smooth out PV intermittency and cover short term power shortfalls, while relying on an integrated diesel generator to cover longer term power shortfalls. As a result, high-cost diesel generation is significantly reduced (though not eliminated entirely) while expensive battery hardware can be sized efficiently. These and other system integration innovations may make storage more viable for C&I customers.

2.5 C&I Solar Boom Will Be Unlocked with Financing Innovations

Financing has been the major barrier to the development of C&I solar in the region. Because credit is so expensive in East Africa, businesses often fund capital expenditure in cash and expect capital improvements to yield short paybacks of two or three years. The relatively high unit costs of sub utility-scale solar development do not yet allow for this payback timeline to be met. To overcome this sales challenge, developers are offering C&I projects to customers under either a PPA or a lease model, which allows for minimal down payments and for project savings to be amortized over a period of ten or more years.

These third-party contracted projects are difficult to finance. At $2 million or less, they are usually too small to be individually assessed by the DFIs who typically back utility-scale PV projects in the region. Small-scale developers are typically thinly capitalized and may risk losing deals while they undertake the lengthy process of raising project financing. For financing purposes, it makes sense to package multiple projects together, both to diversify project risks as well as to spread out transaction costs across multiple deals. At this early stage, however, the volume of C&I deal flow in East Africa makes transaction packaging difficult.[clxxxii]

To address financing challenges in the nascent but promising East African C&I solar market, CrossBoundary, an African investment advisory firm, has raised a dedicated fund. The initial $8 million fund closed in December 2015, anchored by a $1.3 million investment by USAID's Power Africa program. CrossBoundary expects this $8 million to unlock additional debt financing at approximately 8%.[clxxxiii] The fund plans to buy out C&I solar developers who have struck PPAs over a two to three-year period, injecting critical liquidity into the new market and allowing developers to rapidly recycle capital.[clxxxiv] It is hoped that the Nairobi-based fund is nimble enough to match the quicker project cycles of C&I solar development.

The introduction of CrossBoundary's dedicated C&I fund is an encouraging development in a very promising market. Solar costs continue to decline, while on-grid power prices remain relatively high in the region. C&I projects circumvent issues of land acquisition and government approvals, which frequently challenge utility-scale projects. Financial innovation, successful demonstration projects and time will likely unlock a sizeable market. If just 20 percent of Kenya's largest 5,000 electricity customers were to build 200 kW onsite PV arrays, Kenya would add 200 MW of distributed PV to its power system, surpassing the amount of utility-scale PV projects likely to come online in the next five years.

Conclusion:

With less than one-quarter of the population connected to the grid, and fast-growing energy demand, East Africa has a tremendous need for new power generation. While OECD nations are debating the least costly ways to retrofit their grids to produce lower emissions, East African energy planners are contemplating the doubling and tripling of generation capacity within a decade. Yet utility-solar has been very slow to come to the region—to date only one 8.5 MW utility solar project has been completed in Rwanda.

These countries have been slow to build utility-solar projects in large part because they have a wealth of domestically-produced alternatives. Kenya has a favorable wind resource, vast geothermal potential, and, increasingly, the option of importing cheap hydropower from Ethiopia. Uganda can continue a 70-year pattern of building large dams. Rwanda can burn peat or methane gas from Lake Kivu. Tanzania is slowly developing its coastal natural gas resources.

At the same time, solar PV has significant advantages. It is a low-carbon resource. Unlike a megadam or the drilling, piping and firing of natural gas, solar can be built very quickly—the Rwandan PV project was financed and built within just one year of PPA signing. Solar can also be built virtually anywhere with high sun—a large portion of this region.

However, PV power is intermittent and non-dispatchable, and thus challenging to integrate into national grids. The Rwandan solar project discussed above represented 6% of national power capacity at construction. It is still not clear that the Rwandans will go forward with a second PV plant anytime soon, and if they do the wholesale tariff will be much reduced, reflecting the reduced marginal value of solar as penetration grows.

With ample alternatives and potential integration challenges, East African governments have not greatly incentivized solar with wholesale prices high enough to attract independent developers. Kenya's $0.12/kWh tariff was challenging to developers in 2014/15, though is becoming more attractive as costs fall. Uganda's $0.11/kWh is even tighter—and the country has only been able to start construction on two 10 MW solar plants through a donor subsidy. Tanzania does not have a fixed Feed-in-Tariff but the shaky credit quality of the national utility deters investment at nearly any tariff. The government could address this issue by offering sovereign guarantees for utility-contracted solar projects, but this would pull scarce government resources away from higher development priorities.

There are some steps that East African countries can take to accelerate utility-solar PV development without paying higher solar tariffs or assuming utility liabilities. Reforms that make land title more transparent, more easily transferable, and more secure would ease a major challenge to regional solar investment (and no doubt catalyze investment into other sectors). Revenue authorities might also clarify the murky import exemptions for "solar equipment", as ambiguity has delayed at least two utility-scale projects in the region.

Finally, on the development process, energy regulators could do more to screen out non-credible PPA-seekers, adopt internationally “bankable” draft PPAs, and respond faster to qualified developers during PPA negotiation process. These institutional reforms would shorten development timelines, risks and costs.

Remarkably for a region suffering from under-investment in infrastructure, financing is not seen as the bottleneck for utility solar projects. Though domestic debt markets do not currently support the sort of low-rate, long tenor debt required for solar project finance, there is ample appetite and capital from Development Finance Institutions (DFIs) to fill in the gap. The challenge, at the moment, is that there are not enough “quality” deals to finance—solar projects with secure land rights and well-negotiated PPAs with a solvent utility. Hopefully the supply of these “bankable” deals will grow in the future, but for the time being the capital is adequate to fund the solar project pipeline in East Africa.

In contrast to utility projects, C&I solar projects are not reliant on government but still challenging to finance. C&I projects make sense in much of the region because retail electricity rates are high, land acquisition is less of an issue, and there is, at least for now, little interference from utilities or government agencies. Off-grid customers or those on an unreliable grid may today be relying on expensive diesel generation, which further improves the relative economics of solar power.

There are thousands of potential C&I customers across East Africa. The challenge is to quickly and cheaply finance these projects, which are usually too small to be individually evaluated by international DFIs. Ongoing efforts to deploy concessionary debt financing through local banks, which are better able to assess customer creditworthiness, are encouraging. In addition, funds have been raised to buy out C&I projects once they have been contracted and this should add some liquidity to the development market. Financial innovations such as these may unlock the attractive economics of C&I deployments, which might eventually eclipse utility-scale deployments.

Utility-scale solar power is unlikely, in the near term, to become more than a niche part of the growing energy grid in East Africa. Though each country could make small reforms to accelerate nascent development of utility-scale solar plants—none should subsidize this intermittent power source over other economical generation sources, especially those with low carbon emissions. Thus utility solar will remain at best a modest contributor to the East African utility grids unless better integrated through energy storage, and the prices for both fall dramatically.

In contrast, the economics for C&I solar are more compelling. A small boom in C&I deployments is more likely than a boom in utility-scale solar development. C&I growth is largely out of the hands of government and more dependent on the creativity of financiers to stretch project finance models to smaller projects.

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[ciii] Twaha Twagirimana reported 6.0 hrs of sun at the Agahozo site, while B. Safari and J. Gasore calculated annual irradiance levels at 4.9 to 5.6 hrs across various sites in Rwanda (http://www.scialert.net/fulltext/?doi=ajsr.2009.68.75)
[civ] Interview with Chaim Motzen, formerly Gigawatt Global, January 2016
[cv] Interview with Twaha Twagirimana, Scatec, Agahozo, Rwanda, December 16, 2015
[cvi] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Rwanda_-_Energy_Sector_Review_and_Action_Plan.pdf
[cvii] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Rwanda_-_Energy_Sector_Review_and_Action_Plan.pdf
[cviii] Interview with Eric Kariningufu, 3E Power, Kigali, December 17, 2015
[cix] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Rwanda_-_Energy_Sector_Review_and_Action_Plan.pdf
[cx] http://www.newtimes.co.rw/section/article/2015-09-01/192094/
[cxi] Interview with Chaim Motzen, formerly Gigawatt Global, January 2016
[cxii] Interview with Trevor Green, Remote Group, Kigali, December 16, 2015 and Gregoire Doucet, CDN, December 18, 2015
[cxiii] Interview with Twaha Twagirimana, Scatec, Agahozo, Rwanda, December 16, 2015
[cxiv] Interview with Chaim Motzen, formerly Gigawatt Global, January 2016
[cxv] Interview with Eric Kariningufu, 3E Power, Kigali, December 17, 2015
[cxvi] Interview with Twaha Twagirimana, Scatec, Agahozo, Rwanda, December 16, 2015
[cxvii] Interview with Chaim Motzen, formerly Gigawatt Global, January 2016
[cxviii] Interview with Chaim Motzen, formerly Gigawatt Global, January 2016
[cxix] (1) Interview with Eric Kariningfu, 3E Energy, Kigali, December 17, 2016 (2) http://www.renewableenergymagazine.com/article/major-solar-energy-facility-to-be-constructed-20140602
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[cxxii] Interview with representatives of Kivu Solar, Kigali, December 17, 2015
[cxxiii] Interview with Gregoire Doucet, CDN, December 17, 2015
[cxxiv] Interview with Eric Kariningfu, 3E Energy, Kigali, December 17, 2015
[cxxv] Interview with Eric Kariningfu, 3E Energy, Kigali, December 17, 2015
[cxxvi] Interview with Gregoire Doucet, CDN, December 17, 2015
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[cxxxvii] Interview with Steve Wasira, Private Sector Transaction Advisor, Tanzania Rural Electricity Agency, Dar es Salaam, December 21, 2015
[cxxxviii] Interview with Peter Gathercole, Symbion Power, Dar es Salaam, December 22, 2015
[cxxxix] Interview with Peter Gathercole, Symbion Power, Dar es Salaam, December 22, 2015
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[cxliv] Interview with Jared Wren, Hecate Energy, January 2015
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[cxlvii] Interview with Wakar Kolhoro, GVEP, Nairobi, December 9, 2015
[cxlviii] Interviews with Oscar Ankunda, USAID, Kampala, December 15, 2015, and Trevor Green, Remote Group, Kigali, December 16, 2015
[cxlix] Interview with Mutisya Ndunda, Chase Bank, Nairobi, December 9, 2015
[cl] Interview with Mutisya Ndunda, Chase Bank, Nairobi, December 9, 2015
[cli] Interview with Koffi Klousseh, IFC, Nairobi, December 7, 2015
[clii] Interview with Cliff Aron, GreenMax Capital Advisors, December 5, 2015
[cliii] Interview with Koffi Klousseh, IFC, Nairobi, December 7, 2015
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[clviii] Interview with Tomas Adcock, Nairobi, December 7, 2015
[clix] Interview with Kenya energy expert, remaining anonymous
[clx] Interview with Oscar Ankunda, USAID, Kampala, December 16, 2015
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[clxxvii] Interview with Kevin Gaitho, Strathmore University, Nairobi, December 5, 2015
[clxxviii] Interview with Mark Hankin, African Solar Design, Nairobi, December 10, 2015
[clxxix] Interview with Eugene Obiero, Camco Clean Energy, Nairobi, December 8, 2015
[clxxx] Interview with Nicolas Tatrallyay, Berkeley Energy, Nairobi, December 2015
[clxxxi] Interview with Matt Tilleard, CrossBoundary, Nairobi, December 10, 2015
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[clxxxiii] Interview with Matt Tilleard, CrossBoundary, Nairobi, December 10, 2015
[clxxxiv] Interview with Matt Tilleard, CrossBoundary, Nairobi, December 10, 2015