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TITLE: LEVERAGING IMPACT INVESTMENT FOR TRANSFORMATIVE IMPACT AROUND ACCESS TO CLEAN AND SAFE ENERGY IN EASTERN AND SOUTHERN AFRICA

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Abstract

In spite of wide spread consensus on the catalytic role that renewable energy (RE) can play to enable energy access in Southern and East Africa, private investment has been unwilling to invest to the extent that is needed to address existing energy poverty. To date most of the investment in small scale RE such as mini-grid application and household application have been driven by government and donor funding. The reasons underpinning the reluctance of private sector investors are well known and also documented in this paper. This begs the critical question: What is necessary to move the private and commercial capital necessary to have transformative impact in Southern and East Africa around access to clean and safe energy?

This paper posits that impact investment can be the vehicle that mobilizes the much needed mainstream commercial capital to expand access to energy at scale, particularly through decentralized and off-grid sustainable energy systems. Impact investment can pave the shift away from traditional approaches or government led, donor assistance and aid led solutions, which are often limited by budget and are scattered, to attracting large scale commercial capital that can boost energy access. The main objective of this paper is therefore to examine how impact investment can play this role effectively.

In this respect, the paper begins with an overview of the macro-level energy situation in Africa and in particular the regions under discussion. It then provides an understanding of the market for energy access through the identification of users of energy and energy needs and the untapped potential. Such an understanding of the market is important because the solutions and interventions required to successfully address the requirements of different users and fulfil differing energy needs, thereby improving access, will be different and because the level of energy provided by different technologies and the potential impacts are different. It discusses the challenges to delivering energy access at scale, with particular emphasis on finance. Best practices and case studies are used to explain how innovative business models have facilitated both modes of payment that attempt to address financing challenges, particularly end user affordability constraints and the acceptance of RE technologies for energy access. It concludes with suggestions on the specific role that impact investment can play to unlock the potential of small scale RE in Sub-Saharan Africa to drive both household and productive applications.

About the author/s

Manisha Gulati is an economist who specialises in the areas of energy, climate change, low carbon development, and resources nexus. She has over 16 years of experience in advisory, research and capacity building in these areas. She has worked in Asia, Africa and Europe where she has advised governments, business, global policy makers, donors, and civil society and delivered high-impact research initiatives. Manisha holds a Masters in Business Economics from the University of Delhi, India, and a BA (Hons) in Economics from St. Stephen's College, University of Delhi.

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1. Introduction

In spite of wide spread consensus on the catalytic role that renewable energy (RE) can play to enable energy access in Southern and East Africa, private investment has been unwilling to invest to the extent that is needed to address existing energy poverty. To date most of the investment in small scale RE such as mini-grid application and household application have been driven by government and donor funding. However, this will not be enough to unlock the full potential of small scale RE to address energy deficits in the region. The reasons underpinning the reluctance of private sector investors are well known and also documented in this brief. This begs the critical question: What is necessary to move the private and commercial capital necessary to have transformative impact in Southern and East Africa around access to clean and safe energy?

However, the terrain is rapidly changing. Already there is evidence of emerging and innovative energy service models that are driving new opportunities for off-grid electrification and accelerating energy access. However, in order to scale and replicate these, it is critical that countries create a receptive environment – institutions, policies, strategic planning, regulations and incentives - to attract private finance World Bank, 2017).

This paper posits that the answer is impact investment has a critical role to play in overcoming the reluctance of private investors. Impact investment can be the vehicle that mobilizes the much needed mainstream commercial capital to expand access to energy at scale, particularly through decentralized and off-grid sustainable energy systems. Impact investment can pave the shift away from traditional approaches or government led, donor assistance and aid led solutions, which are often limited by budget and are scattered, to attracting commercial capital that can boost energy access. The main objective of this paper is therefore to examine how impact investment can play this role effectively.

In this respect, the paper begins with an overview of the macro-level energy situation in Africa and in the regions under discussion. It then provides an understanding the market for energy access by way of users of energy and energy needs and the untapped potential. Such an understanding of the market is important because the solutions and interventions required to successfully address the requirements of different users and fulfil differing energy needs, thereby improving access, will be different and because the level of energy provided by different technologies and the potential impacts are different. The next section discusses the challenges to delivering energy access at scale, with particular emphasis on finance. Best practices and case studies have been used to explain how innovative business models have facilitated both modes of payment that attempt to address financing challenges, particularly end user affordability constraints and the acceptance of RE technologies for energy access. It concludes with suggestions on the specific role that impact investment can play to unlock the potential of small scale RE in Sub-Saharan Africa.

2. Energy overview

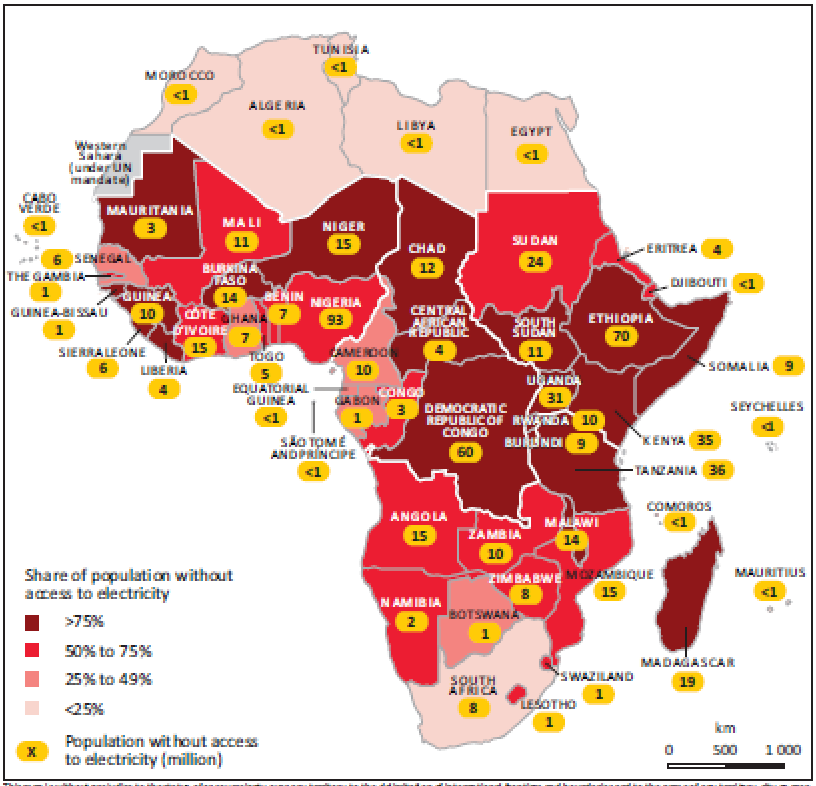
Nearly 600 million people in Africa lack access to electricity (see figure 1) which impacts on the ability to improve human development interventions targeting improvements in productivity, health and safety, gender, equality and education. This statistic is particularly disconcerting in view of existing research that demonstrates a clear correlation between human development and electricity consumption (Alstone et al., 2015). A review of the SDG targets highlights that energy is interconnected with 125 of the 169 targets, demonstrating the key linkages between energy and the overall development agenda (World Bank, 2017). The grid electrification rate in Africa stands at 43% of its population and urban electrification is at 70% while only 28% of the rural population has access to grid electricity. The cost of electricity generation is exceptionally high and generation capacity of less than 200 MW does not meet the minimum efficiency scale in most of countries.

In East Africa, electricity access rates range from 1 per cent in the new State of South Sudan, 9 per cent in the Democratic Republic of Congo (DRC) to 12 per cent in Uganda, 14 per cent in Tanzania, 18 per cent in Kenya and 22.5 per cent in Ethiopia (United Nations Economic Commission for Africa, 2014). The statistics are similar in Southern Africa with electricity access rates ranging from a low of 9% in Malawi and 15% in Madagascar to near 100% in Mauritius and Seychelles and 87% in South Africa. Not unsurprisingly, countries with the highest poverty levels tend to have lower access to energy services (World Bank, 2017).

Whereas increasing access to energy in rural areas have historically been a major challenge, as evident from the statistics above, Africa's rapid urbanization will also impact on existing levels of electrification. With the urban population in Sub-Saharan Africa projected to increase from 38% in 2010 to 52% in 2040, residential demand for electricity alone is projected to increase fivefold. This dramatic increase in electricity demand in the prevailing situation of inadequate and ageing transmission and distribution (T&D) infrastructure and shortage of generation capacity means that urban energy poverty is like to grow. Overall, while 1 billion will gain access to electricity by 2014, an estimated 530 million will still not have access due to population growth (IEA, 2014).

The other facet of sub- Saharan Africa's energy shortage is the lack of energy for cooking. More than 700 million people rely on traditional biomass based cooking fuels such as wood, charcoal, dung and agricultural residues (ref). This number is projected to increase to 880 million by 2020 (IEA 2014). In the East African countries of DRC, Tanzania and Ethiopia - the reliance of the population on biomass is above 90 per cent (United Nations Economic Commission for Africa, 2014). This high reliance of biomass causes high levels of indoor pollution that impact disproportionately on the mortality and morbidity rates of women and children (World Bank, 2017).

Figure 1: Number and share of people without access to electricity in Africa, 2012



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

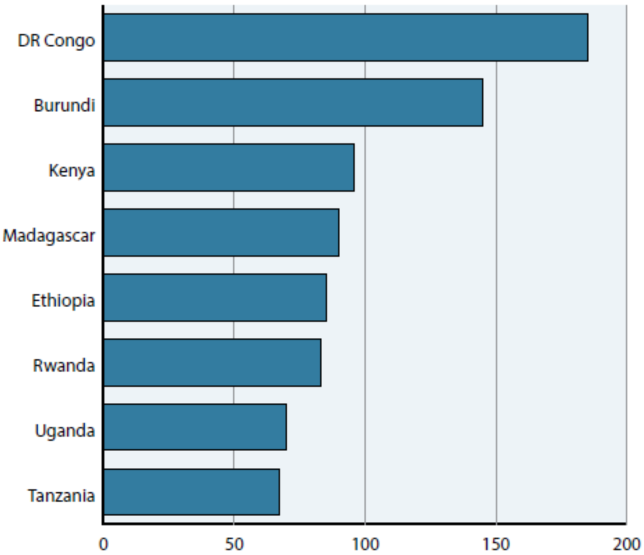
Source: IEA 2014

In addition, in order for energy access to be transformative, there should be a strong focus on the productive uses[1] of electricity sources (World Bank, 2017). However, reliable data on access to thermal energy on the continent for productive uses is not available. This may be partly because industries and enterprises in the formal sector industries usually rely on oil, while those in the informal sector, particularly those in rural areas rely mostly on wood fuel.

However, it is well known that shortage of electricity also poses a significant challenge for the continent's industrial production. Poor system reliability by way of service interruptions and the duration of interruptions pose high costs for industries in the form of diesel based back-up generation capacity and lost sales. In 2008, manufacturing enterprises experienced power outages on an average of 56 days per year (Eberhard et al, 2008). It is further estimated that losses by way of forgone sales and damaged equipment are as high as 6 percent of turnover on average for firms in the formal sector, and as much as 16 percent of turnover for informal sector enterprises that lack their own backup generation (ibid).

[1] Productive uses are defines as agricultural, commercial and industrial activities that require electricity services as direct inputs to the production of goods or delivery of services (World Bank, 2017)

Figure 2: Power outage days in select Eastern African countries



Note: Data is for the following years: DRC (2010); Madagascar (2009); Uganda (2006); Burundi (2006); Tanzania (2006); Kenya (2007); Ethiopia (2011) and Rwanda (2011)

Source: United Nations Economic Commission for Africa, 2014

The scale of the challenge is known and there are many initiatives at both multilateral and national level to address it. These initiatives have translated into a definite positive trend in energy access in most countries with more households and businesses having access to electricity today than in past.

However, the current pace of providing grid access is not keeping pace with the growth in population, urban migration and the amount of energy required for socio-economic transformation (Embassy of the Kingdom of Netherlands, 2015). This is due to a variety of factors. In Africa, 'complex geography, long transmission distances and diffuse populations' in rural areas that inhibit grid extensions because of 'high marginal cost compared to expected usage' (Astone et al., 2015: 307).

It is now acknowledged that grid extension efforts will be inadequate and that de-centralized solutions such as distributed small scale RE, in particular solar, have a major role to address access challenges. Based on date from the IED, Sustainable Energy for All (SE4ALL) expects that reaching universal access will require grid extension for all new urban connections and 30% of rural populations. The remaining 70% of rural people will only gain incremental access through a variety of decentralized solutions such as micro[2] or mini-grids[3] (65 percent) and solar home systems and intra-household or 'pico-solar' products (30 percent) (Alstone et al., 2015; World Bank, 2017). See Table 1 below that sets out the basic characteristics of electricity access technology options with descriptions of the typical range of generation capacity, fuel mix, services available, and the degree to which economic, geographic, and political isolation is a barrier to adoption

[2] Grids that are locally managed, have less than 10MW of installed capacity, serve households and an area of up to 50 kilometers
[3] Less than 100kW of capacity at lower voltage levels and covering a radius of up to 8 kilometers (World Bank, 2017)

Table 1: Characteristics of electricity access technology options and barriers to adoption

Technology	Generation Capacity (Watts)	Services Available	Energy Isolation Barriers
Incumbent technology bundle. Fuel Based Lighting, Dry cell batteries, Fee-based mobile phone charging	N/A	Lighting, Radio communication reception, Two-way mobile communication.	**Economic**: Very Low barrier. Day to day payments for increments of energy. **Geographic**: Low barrier. Requires distribution to remote areas through normal supply chains with some mark-up. **Political**: Low barrier. Gov't and institutions can support market or hinder depending on policies.
Pico Power Systems	0.1 – 10	Lighting, Radio communication reception, Two-way mobile communication. (Note: basically the same as incumbent bundle)	**Economic**: Low barrier. Market-based dissemination. Retail cost USD 10-100. **Geographic**: Low barrier. Requires distribution to remote areas. **Political**: Low barrier. Gov't and institutions can support market or hinder depending on policies.
Solar Home Systems	$10 - 10^3$	Same as above plus television, fans, additional lighting and communication, limited motive and beat power.	**Economic**: Medium barrier. Market-based dissemination. Retail cost USD 75-1,000. **Geographic**: Low barrier. Requires distribution to remote areas. **Political**: Low barrier. Gov't and institutions can support market or hinder depending on policies.
Micro-grid	$10^3 - 10^6$	Same as above with opportunity for community-based service with higher power requirements e.g. water pumping or grain milling.	**Economic**: Medium to high barrier. Requires financing or investment aggregation for large capital outlay but offers relatively low marginal cost electricity to users. **Geographic**: Medium barrier. Requires critical density of population. **Political**: Medium barrier. Requires community support and local political decisions.

Regional Grid	10^6 - 10^9	Depending on the quality of connection, same as above up to a full range of electric power appliances, commercial and industrial applications.	**Economic**: Medium to high barrier. Often high initial connection costs, but low cost power after connection. (Cost of power lines) **Geographic**: High barrier. Requires nearby transmission and distribution infrastructure. **Political**: High barrier. Depends on ministerial and departmental decisions about extension.

Source: Kammen et al. 2014

Non-technical barriers to the large scale uptake of off-grid electricity present the biggest hurdles, namely the lack of investment capital and business models, complex and perverse policy environments inhibited new entries, with subsidies for liquid lighting fuels an obvious example[4], and lack of accurate knowledge about the quality of technologies that leads to 'market spoiling' (Alstone et al. 2015: 310; World Bank, 2017).

This seems set to change with a rapid increase in the uptake of off-grid RE systems. Cheaper technologies, in particular solar panels, batteries and related distributed technology and enabling policies have led to an increase in uptake of small scale RE by users in Africa (Roberts, 2015). Kenya, Tanzania and Ethiopia which collectively has the largest penetration of small scale RE, all have comparatively supportive policies for solar household solutions.

Mini- grids are emerging a key intervention for cost-effective and reliable electrification in rural areas. Projections show that up to one-third of total investments towards universal energy access by 2013 will be directed at mini-grids, with the bulk of those coming from renewable energy generation (World Bank, 2017)

Consumers are also becoming more aware of the financial and health benefits (Scott et al., 2016). In Kenya M-Kopa's household solution (discussed below) replaces kerosene that emits acrid smoke that burns the eyes, irritates the throat, and slowly turns walls and ceilings black. It's also expensive. According to a 2014 survey, an average off-grid household in Kenya spends about 75¢ a day on energy, or $272 a year—$164 on kerosene, $36 on charging their mobile phone, and $72 on batteries. M-Kopa estimates a customer saves about $750 over the first four years by switching to its basic solar kit (Ferris, 2015).

However, the single most important change, is the 'emerging continuum of technology systems that provide access to electricity by harnessing now ubiquitous information technology' (Alstone, 2015: 305), in the process addressing challenges relating to end-user financing. Alstone, 2015: 311 refers to this as the 'information-energy nexus' and highlights the important role of wireless communication networks and increasing access to mobile phones in the developing world, to provide an important support system for decentralised power. 'Targeted and well-designed "killer

[4] Nigeria, Gabon and Angola all have subsidies for diesel and gasoline (WEO, 2015).

applications" of information technology' offers the potential to fast track to development of off-grid solutions and increase energy access.

In the past, the inability of consumers to access finance was the result of various factors; the paucity of financing options that spread consumer investment over a time period that is aligned to the person's budget; a lack of appetite shown by finance providers to develop products for the energy poor; and the inability of energy product and distribution companies to directly finance end-users (CEEW, 2015: 9). The new models referred to above, allow people to pay as they go rather than 'muster large chunks of capital upfront' coupled with information technology that enable the reduction of the transaction costs of coordination among small-scale energy users and producers (Roberts, 2015). Key to note is that a critical success factor of this model is cell phone access which makes it less suitable for areas with low cell phone coverage such as Ethiopia.

However upstream financing for decentralised RE enterprises remains a challenge. This is largely due to the

> ...small project and ticket size of transaction, limited track record of the enterprises, lack of working capital, limited understanding of off-grid projects among financiers and investors and uncertain policy (threat from extension of grid in the case of micro grids) and subsidy disbursal regime (CEEW, 2015: 9).

As the case studies on M-Kopa and SunnyMoney (discussed below) demonstrate, unlocking end-user finance that demonstrate demand for and acceptance of RE technology as well as the ability and willingness to pay enable enterprises to make the business case to access upstream financing.

3. What is the market for energy access?

3.1 Energy access as multi-dimensional challenge

The International Energy Agency observes that there is no single internationally-accepted and internationally-adopted definition of modern energy access.[5] Others have pointed out the existence of a number of definitions, ranging from numerical minimum requirements to social and economic criteria (Modi et al. 2005). The World Bank observes that in the past, access to energy was synonymous with household access to electricity. More generally, energy access was referred to in the context of rural and remote areas. This traditional interpretation of energy access ignores the multidimensional nature of energy access. Moreover, electrification alone is unlikely to resolve the energy access problem because of low penetration of electricity in the energy mix of those that currently lack access to electricity. It is not surprising then that the definition of energy access has undergone several changes in recent years and that the net has been wider.

The World Bank has redefined energy access as the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, legal, convenient, healthy, and safe for all required energy applications across households, productive enterprises, and community institutions. The IEA points out that energy access includes: household access to a minimum level of

[5] http://www.worldenergyoutlook.org/resources/energydevelopment/definingandmodellingenergyaccess/

electricity, household access to safer and more sustainable cooking and heating fuels[6], access to modern energy that enables productive economic activity, and access to modern energy for public services. The United Nations Secretary General's Advisory Group on Energy and Climate Change (AGECC) defines energy access to mean access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses.

3.2 Who needs access to energy?

Given the context of Africa's energy challenges, this discussion brief uses the more advanced and holistic definitions outlined above to identify the market for energy access (see Table 2). The understanding of the market by way of who needs energy and for what service is important to design effective interventions. Moreover, the level of energy provided by different technologies and the potential impacts are different. However, this discussion brief does not undertake a 'back to basics' or bottom up identification of these solutions and interventions. Rather it relies on the significant amounts of work that has already been done by a variety of stakeholders to suggest these solutions and interventions.

It is important to note that although the shortage of electricity has been identified as a major challenge for the continent, Africa needs base load power to drive industrialisation. This base load power can only be achieve through the grid. (Peo, 2015 &2016 and WWF & REEEP, 2015). A related issue here is that the majority of grid based electricity demand will continue to come from industrial and commercial users. However, the focus of this discussion brief is energy access for households and small scale industry level and the role of mini-grids and appropriate technologies to support this objective. Energy access for large and medium industries and commercial consumers does not fall within the scope the brief.

Table 2: Market for energy access

Needs	Basic needs			Productive needs	
	Lighting	Cooking	Heating	Water pumping	Mechanical power
Users					
Households					
Rural					
Urban					
Urban poor					
Peri-urban					
Suburban					
Communities					
Healthcare					
Schools					
Manufacturing					
Small and micro enterprises					

[6] ESMAP. 2015. Beyond Connections: Energy Access Redefined. Conceptualization Report. The International Bank for Reconstruction and Development/The World Bank Group. Washington DC

Agriculture					

Table 3: Possible interventions for energy access for identified markets

Needs	**Basic needs**			**Productive needs**	
	Lighting	**Cooking**	**Heating**	**Water pumping**	**Mechanical power**
Users					
Households					
Rural	Solar lanterns, Solar home Systems, Mini-grids powered by solar PV, small hydro or wind	Biomass improved cook stoves, solar cookers, biogas	Solar water heaters		
Urban					
Urban poor	Solar lanterns, Solar home Systems, Grid	Liquified Petroleum Gas (LPG) cooking fuel and stoves, solar cookers	Solar water heaters		
Peri-urban	Grid	LPG cooking fuel and stoves	Solar water heaters		
Suburban	Grid	LPG cooking fuel and stoves	Solar water heaters, grid		
Communities					
Healthcare	Solar home systems Mini-grids powered by solar PV, small hydro or wind, Grid	Biomass improved cook stoves, LPG cooking fuel and stoves, solar cookers	Solar water heaters		
Schools	Solar home systems Mini-grids	Biomass improved cook stoves,	Solar water heaters		

	powered by solar PV, small hydro, wind, biogas, waste, Grid	LPG cooking fuel and stoves, solar cookers			
Manufacturing					
Small and micro enterprises (embedded in rural or urban poor households)	Solar home systems, Mini-grids powered by solar PV, small hydro, wind, biogas, waste		Solar water heaters		Solar dryers, solar refrigeration, Biogas from small- and medium-sized digesters, Mini-grids powered by solar PV, small hydro or wind
Agriculture				Solar PV based pumps, Mechanical wind pumps	

As seen from Table 3, there is no single solution to energy access. While grid extension is the most suitable option for urban households as well as communities based in urban areas, mini-grids and off-grid devices will play a greater role as far as needs such as lighting, cooking and productive uses of electricity are concerned. As compared to off-grid devices, mini-grids can help to improve the reliability of supply, and can provide more energy and three-phase electricity, thus making it possible to meet additional loads. They also fulfil multiple energy needs.

4. Size of the potential market

Evidently the market is significant. It is estimated that bringing the electrification rate in sub-Saharan Africa up from 32% today to 70% in 2040 will cost around $205 billion in capital investment. Mini-grids and off-grid solutions that are less capital-intensive and require less investment in infrastructure account for around 30% of the total. Southern Africa will require around $65 billion and East Africa around $50 billion (WEO, 2015).

The market for solar household solutions that are quality certified has reached almost 3.5 million units in 2014 reflecting market growth of 165% between 2011 and 2012 and by 204% between 2012 and 2013. This growth flattened out between 2013 and 2014 when the increase fell to 27%, and indications are that it declined in the first half of 2015 (Scott et al., 2016). Although dependable data on non-certified products is unavailable, Lighting Africa estimated that they had a 57% share of the total market in 2012 (Lighting Africa, 2012 in Scott et al., 2016), pointing to a growth in increased volumes in non-certified products that could still translate into overall market growth. Kenya, Tanzania and Ethiopia are collectively the biggest market with 78% of the sales in 2014 and reaching a market penetration of 15-20% of off-grid households. While Rwanda and Uganda's markets are still small they are generally regarded as the next emerging markets (Scott et al., 2016).

Regionally, market penetration is estimated to be around 3% with over 90% of the products sold below 10W in capacity. Sales are predominantly entry-level products, although there is some indication that some consumers will proceed and upgrade their present systems, adding capacity or functionality (Scott et al., 2016).

Predicting future growth has proven difficult with insufficient data in all the key variables, demand, supply, policy, and finance factors. In order to deal with this constraint, Scott et al. (2016) developed a simple model to get an understanding under three scenarios to achieve universal access, Business as Usual, Sustainable Energy for All, and Power for All based on the assumption that universal access is achieved by 2080, 2030 and 2025, respectively. Underpinning the model is the premise that the amount invested annually is the most important factor impacting on the growth rates. This in turn is affected by four factors demand, supply, policy and finance. The model focuses on three quality-certified product categories, estimating the annual sales for each that would be possible with the investment raised. This then determines the number of people who gain access to electricity each year. The main findings of the model are summarised in Table 4.

Table 4: Year that universal access is achieved under each scenario

	Business as Usual	SE4All	Power4All
Sub-Saharan Africa	> 2030	2030	2025
Ethiopia	2019	2019	2018
Ghana	> 2030	> 2030	> 2030
Kenya	2019	2019	2018
Malawi	2028	2026	2023
Mozambique	> 2030	> 2030	2027
Nigeria	> 2030	> 2030	> 2030
Rwanda	2024	2023	2022
Sierra Leone	> 2030	> 2030	> 2030
Somalia	> 2030	> 2030	> 2030
Tanzania	2022	2022	2021
Uganda	> 2030	> 2030	2026
Zambia	> 2030	> 2030	2026
Zimbabwe	> 2030	> 2030	> 2030

Source: Scott et al. 2016

As already noted above, data on access to thermal energy on the continent for productive uses is not well captured, but indications are that around 80% of residential energy demand in sub-Saharan Africa is for cooking, compared with around 5% in Organisation for Economic Co-operation and Development (OECD) countries. This is due, mainly, to households prioritising energy for cooking (and lighting) within very restrictive budgets (when paid for) and the low efficiency of the cook stoves used (WEO, 2015). However, it is not possible to replace dirty cooking fuels with solar powered technology. Electrical appliances such as stoves, hotplates and kettles draw an enormous of energy and cannot be supported by these technologies.

From the foregoing it is clear that there is a demonstrable need for solar technology which begs the question, why has there been such a lack of investor appetite to take up the opportunities already unlocked by existing government-led programmes and donor funding aimed at improving energy access already exist explore the market.

5. What are the barriers to achieving higher levels of energy access?

5.1 Issues relating to enabling policy and capacity

The energy access challenge in both Eastern and Southern Africa is massive, requiring far-reaching vision, implementation strategy and regional cooperation. Appropriate policies and regulatory frameworks have a key role to play to support the roll-out of small scale renewable energy solution in Africa. Most importantly is the need to remove policy uncertainly by 'the removal of policy uncertainty, by including off-grid electrification through market mechanisms in national electrification strategy, policy, regulation and plans Scott et al. (2016: 6).

It is worth noting that contrary to popular perception, many countries have plenty of enabling legislation, policies and strategies for energy access in place, and even targets, for both access to electricity and promoting the efficient use of biomass for cooking. (See Box 1 and 2). In fact, the East African Community member States have even advanced a common set of targets for energy access that include access to modern cooking energy for 50 per cent of biomass users, access to energy for all schools, clinics, hospitals and community centres, access to energy services for 100 per cent of urban and peri-urban residents, and access to mechanical power for 100 per cent of communities for productive use. Countries are also working on models for coordination between the public and private sector using donor funding under an overarching energy policy objective to increase both energy access as well as the share of renewable energy in energy consumption.

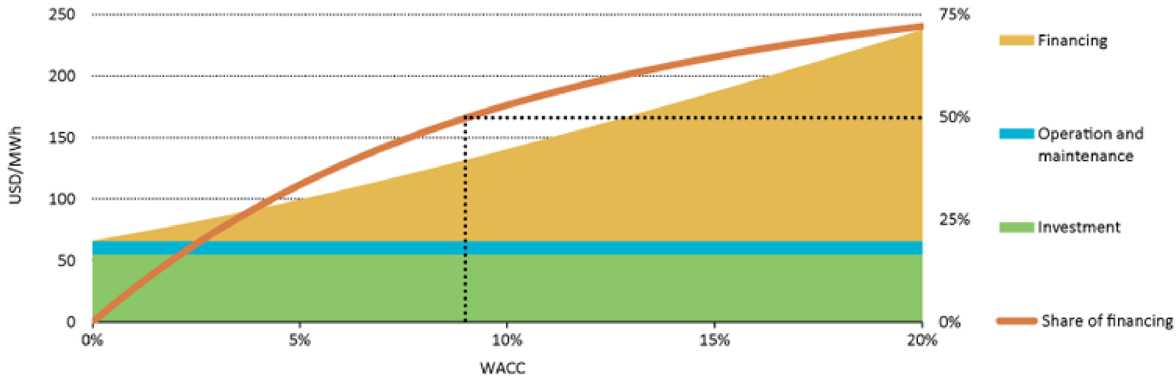
However, these advances in prioritizing and setting policy targets for energy access and renewable energy have not been able to create the much required breakthrough for energy access. The problems lies in 'second order' policy settings such as lengthy permitting and licensing processes involving high transaction costs, taxation of distributed energy products, absence of programmatic approach for firms interested in developing multiple sites, and even tariff setting. For example, countries often adopt standard processes that aim for one-size-fits-all approaches. This impacts the sustainability of business models and can restrict new market entrants. Because mini-grids share some characteristics with utilities, tariffs are regulated and often not granted flexibility to set different tariffs depending on consumer profile. This impairs their ability to recover costs or compete on an even footing with alternatives such as diesel generators.

There are other reasons too. The lack of local expertise poses a significant barrier. Despite strong policy frameworks, institutional responsibilities are not always allocated, with there being no clarity of who is in charge of the overall energy access interventions. Multiple agencies sometimes mean that there is no co-ordination between these agencies. The institutional capacity for implementation also remains weak. Then there is the lack of skills. The development and operation of interventions such as mini-grids requires expertise in assessing local conditions, installing generation equipment and grid systems, the maintenance of these systems and financial management. In case of hybrid systems, the requirement of these skills becomes more pertinent because they involve more diverse generation technologies and more complex management systems. The biggest impediment, however, remains finance.

5.2 Accessing finance

Although public investment from governments and donor agencies is available, these resources are limited and cannot meet the magnitude of the energy access challenge. First, the cost of finance poses a significant challenge. Cost of capital for RE based projects in Africa remains high due to high levels of risk associated with off-takers, less sophisticated financial markets, poor contracts enforcement, ease to exit markets, poorly structured electricity markets and inability of users to pay for services. This means that even with levels of solar radiation at par with those in more financially developed markets and same system prices, the weighted average cost of capital can result in in costs (and tariffs) of RE being doubled in Africa (see figure 3). The higher cost of capital coupled with the general low levels of development of traditional financing markets (including banking sector) in African countries means that lending structures become further unattractive.

Figure 3: Impact of cost of capital on the levelised generation cost of solar PV (assuming same system price and solar irradiation)



Source: Frankl, 2015

Second, access to finance is an impediment for projects and companies alike. Different types of projects require different types of finance based on the size and type of the project. While large scale projects find funding more easily through large commercial banks given that they are suitable for project finance structures and are often accompanied by sovereign guarantees, it remains difficult to obtain financing for small and medium-scale renewable energy projects, This makes the higher upfront investment costs of many renewable energy installations challenging to bear. The high transaction costs associated with small projects also mean that these projects are not amenable to financing by commercial banks and need other types of financing.

Often the equity requirements posed by commercial banks make projects unviable. In East Africa, for example, commercial banks require contribution of 30-40% of project costs in order to qualify for a loan, which is beyond the reach of small project developers (GVEP International, 2014). Generally solar companies indicate that they can raise 20% of their annual capital needs which is equal to approximately $300 million. At this point, only the largest companies are in a position to raise significant amounts of investment. While equity made up about 80% of funding, debt financing has increased as mixed investments have grown (Scott et al, 2016).

It is also for this reason that despite there being enough examples of locally tailored and feasible interventions (Box 3) as well as innovative business models (see Boxes 4 and 5), as demonstrated in this discussion brief, not many proponents of such business models are able to access finance. This is not to say that there are no investments. Having demonstrated both demand and ability to pay, M-Kopa in Kenya was able to access $19 Million in investment finance in November 2015 (Faris, 2015). Similarly, Off-Grid Electricity in Tanzania has been equally successful in raising close to USD 50 million in additional funding to expand into Rwanda and increase its reach in Tanzania. Thus, there is an increased interest from investors, driven both by of the falling costs of solar and batteries and by the groundwork by laid by non-profits and social enterprise models that are able to demonstrate both acceptance of the technology and the willingness to pay for RE services. Yet, these investments by are not enough to deliver the scale of challenge.

Third, energy access requires access to finance at different stages of project/enterprise development. For example, enterprises engaged in the development of projects, distribution and retail need start-up capital while the end users such as households or small and micro enterprises need financial support to buy the energy product. In this regard it has been reported that the average cost of debt is higher than 15% in countries such as Mozambique, implying that access to local finance is restricted (Scott et al., 2016). On the global stage, renewable energy systems and products are witnessing dramatic cost reductions and improved performance. Yet their capital-to-operational cost ratio remains relatively high and the upfront costs of energy products and services such as solar home systems, improved cook stoves and even solar lanterns remain beyond the means of the majority of end-users identified in Table 1.

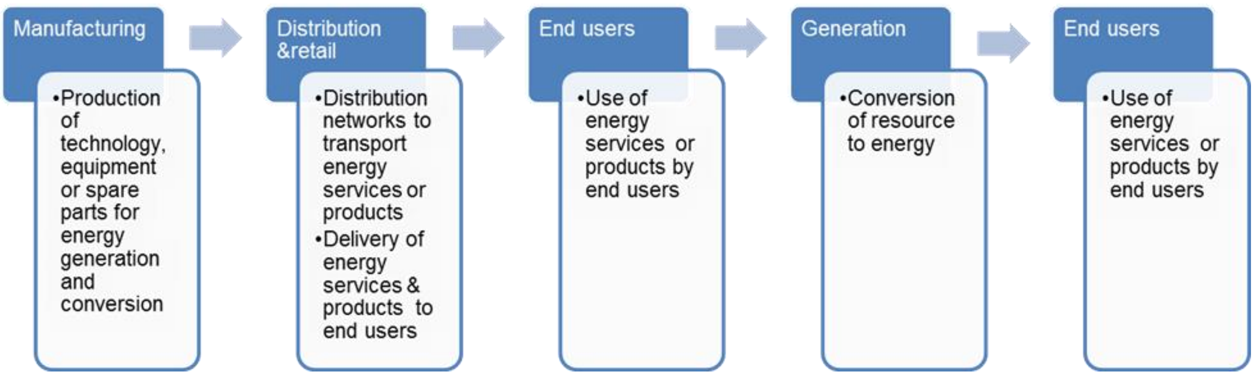
With most Africa countries having small microfinance sectors that have weak coverage of rural areas and interest rates as high as 50-60%, credit from this sector is unaffordable (Scott et al., 2016). Even the large banks have requirements that are beyond the reach of most end-users. For example, it is understood that Tanzanian banks are required to secure no less than 125% collateral, when lending to households and smaller local businesses, in line with the provisions of the National the Banking and Financing Acts of 1991 and 2001 (Haselip et al, 2013). Clearly, the availability of a suite of supply options or well-designed interventions is not a guarantee that households will be able to afford to connect (Embassy of the Kingdom of Netherlands, 2015). Arguably, and as shown in boxes 3, 4 and 5, innovative demand side interventions have been very successful enabling the end user to purchase or lease appropriate technology. In some instances, such as M-Kopa allowed them to demonstrate their business model and use it to leverage additional funding.

Similarly RE based mini-grids are often expensive because it is still expensive to set up a generating plant and mini-grid. No community could completely cover the costs of doing this. Few local lenders offer long-tenor debt financing at feasible rates. The lack of project development funding is another significant barrier. Mini-grid tariffs are often higher than grid-based tariffs, which might impact on off-takers' 'willingness-to-pay' and the long term financial sustainability of the project. Therefore, many energy access interventions are unviable in the absence of upfront support of some kind from governments or donor agencies World Bank, 2017).

Fourth, RE based energy access also requires reliable, qualified and local service providers. But the majority of financial support focuses on projects such as the mini grid or devices per se and ignore the other segments of the energy value chain (see Figure 4). Any investor intending to enter the off-grid business would need the start-up capital and the ability to take risks in the new business. Similarly, in the absence of local manufacturing, much of the continent relies on import and distribution systems that are inadequate. Moreover, the benefits of global price reductions on RE technologies are negated with the addition of logistics and transportation costs that are amplified by the poor infrastructure on the continent. Funding for such logistics often goes ignored.

Then there is the lack of financial support for entrepreneurial activities such as project development, feasibility studies and proof of concepts. Services such as repair and maintenance, provision of spare parts and after-sales are also capital intensive. Generation and distribution equipment must be regularly maintained to operate efficiently and comply with the lifetime expected. The absence of adequate supply chains, long travel distances, and poor transportation and communications infrastructure in rural areas only add to the challenges associated with these services and add to high business costs.

Figure 4: Energy value chain



Source: Authors

In this regard NGO led programmes have a critical role to play, utilizing donor funding to execute pilot projects to develop proof of concept - in particular 'willingness-to-pay' - that can be scaled up. One such an example is *The Clean Energy Champion District Initiative* in Uganda. This initiative that is led by the Kasese District with the support of WWF Uganda Country Office and local and international partners[7] was developed in a response to the high rates of deforestation in the area. Lighting Aid is another example of an organisation that helps to address gaps in the market (Amankwah-Amoah, 2015). (See box 7 below).

Fifth, increased capacity on the supply side does not in itself lead to increased access energy access. Interventions have often been narrowly focused on basic household access without adequate attention to productive uses for income generation. The resulting absence of income to pay for the energy service or to maintain the energy product has rendered many interventions unviable (Sebitori & Pillay 2007; Chambwera & Folmer 2007).

Finally, there are few project developers or service providers with viable and proven operational models that can achieve scale and sustainability. This impedes on their ability to attract finance as project developers need to be commercially viable and achieve scale – either through a large single scheme or by bundling many smaller schemes.

6. Overcoming challenges to energy access through innovation

Some of the issues raised above, are being addressed by innovative business models. Generally there are 5 business models in place in Africa, partnerships between companies and institutions; distributor-dealer channels; proprietary distribution; franchise models; and, rental or leasing systems. These models and accompanying financing are constantly evolving, responding to the dynamic market conditions. Extrapolating from successful installations suggests that a number of common features are shared, namely

> (i)consideration of the demands, interest, and restrictions of local customers, including the desire to pay with mobile payments systems; (ii) strong partnerships along the whole supply chain, from the government and utilities to private sector service providers; and (iii) adaptation of market dynamics to local conditions to support successful, sustainable clean energy solutions (World Bank, 2017).

The dominant trend is the pay as-you-go model that relies on mobile telephony (Scott et al., 2016) and where ownership passes to the consumer after a payment period (See box 5). Another option that has proven effective is the social enterprise model where the private sector works closely with NGOs to unlock markets and with a strong emphasis on building local capacity (see box 4). SolarNow in Uganda is a good example of a works on a franchise model or include a micro lending programme such as FINCA in Uganda and in Tanzania (see box 7).

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[7] Kasese District Local Government, Ministry of Energy and Mineral Development (MEMD), Centre for Renewable Energy and Energy conservation (CREEC),Joint Energy and Environmental Project (JEEP), Barefoot Power Uganda (BFPU). UGASTOVE, - Norwegian Agency for Development Cooperation (NORAD), WWF Norway | WWF Denmark | WWF Sweden, DANIDA | Swedish Post Lottery. | SIDA | (WWF Uganda, 2013).

7. What can impact investors do?

It is well known that the social benefits from access to energy are exponential rather than linear. When this access is delivered through RE technologies as compared to fossil fuel alternatives, the positive multiplier effects become higher on account of health benefits, safer households, reduction of local pollution, and broader environmental benefits, thereby making a compelling investment case for impact investors. The fact that finance is the most pressing challenge to increased energy access and that the private sector will need to play a large role in financing and delivering energy access across Africa also ties in with the most important resource that impact investors bring to the table. Moreover, impact investors can provide long tenor financing that will play an important role in shortening project life cycles while making renewable energy interventions affordable for end users.

7.1 Enhance end user affordability

Impact investors can play a catalytic role in enhancing end-user affordability for energy products by supporting end user financing that is tailored to the consumers' income, cash flow and expenditure on energy services. This is possible by supporting asset finance and micro finance models.

Asset finance typically involves the provision of finance by energy enterprises for energy products to end-users 'in-house' that enables end-users to pay for energy in small increments. Popular models include Rent-to-Own and Pay As You Go and often rely on technology such as mobile payments. Asset finance is increasingly being used to provide electricity to off-grid rural communities through modular, expandable Solar Home Systems (SHSs) (see Box 1). Impact investors can help build and grow end-user finance through technical support and capacity building for identification and management of credit risk, direct investments in proven and credible business models of asset finance, or supporting the scaling up of companies that exhibit an effective business model to this end. In any case, the asset finance model is cash intensive. It requires a stable as well as cheap credit line to finance the operational lease, to manage working capital and to maintain optimum stock levels.

Impact investors can also form partnerships with local NGOs or community based organizations under this model. They can negotiate bulk-purchase agreements with an energy enterprise including low cost distribution and after sales service and ensure deployment of energy products via these partner NGOs. They can also set the quality standards to be met by the energy enterprise for all system components thereby ensuring good quality products for end users.

Microfinance institutions are important as they are the last-mile intermediaries in the distribution and finance of renewable energy products. Impact investors can also provide a steady line of credit to these organizations, local banks or credit cooperatives that provide financial products for energy products or supply energy products alongside financial product offerings, with or without an energy partner (see Box 2). Typically, when a financial institution has an energy partner, it provides credit to an end-user and manages the monitoring and repayment processes, while the energy company provides the energy product, and performs installation and service and maintenance.

7.2 Catalyse commercial capital

Impact investors can catalyse commercial capital to scale existing solutions by de-risking projects and even enterprises. This is possible through provision of upfront capital, loan guarantees, first loss guarantees, bridge financing, low-cost and longer-term debt or sub-debt instruments, and equity funding. This will however not be easy. Experience with mini-grids globally has shown that successful mini-grid projects have secured sufficient upfront funding to carry out detailed design and the construction of high quality infrastructure (GVEP International).

Choosing the right developer or business model to support will be critical. Investors will need to identify promising business models and existing developers that have real scale potential. Therefore, they will need to support developers with some sort of a proven concept by way of completed successful pilots or existing projects and demonstrated consumer demand for their products and services.

Finally, impact investors can provide facilities that cluster projects into a single investment opportunity to allow for a scale that decrease risks, reduces transaction costs and fosters investment. There already exists an increasing depth of development and implementation experience on successful projects and a bundling or aggregation facility would take these projects to scale.

7.3 Provide capital where none exists

Different financial services are needed across the energy value chain to enable the market chain actors to produce the products and services and to deliver them widely. Impact investors can specifically boost the development and entrance of local enterprises to build a strong and sustainable local supply chain through the provision of seed capital to small-and medium-sized enterprises and working capital. They can also facilitate pre-investment activities for small and medium projects. It is evident that many companies have piloted and are beginning to scale interesting approaches to expanding access to energy. These companies now need to replicate their proven models and to build track records, with enough customers over enough time. Impact investors can help these companies by funding initial investments. Once again, such support will allow companies to transition to mainstream investors and begin to unlock private capital for massive scale.

7.4 Recycle capital

Investors should aim for multiplier effects of their funding by stipulating recycling of their funds. For example, when consumers pay for energy service, or pay down their loans, the recovered funds should be set aside to be used again to finance new solutions for the next set of customers. This will ensure that funds are used to scale solutions for the energy-poor, and not be taken out as profits for equity investors in the energy companies or projects.

7.5 Pilot, pioneer and scale

Impact investors can support the testing and refining of a range of new solutions to demonstrate new technology or business models, establish 'investable' business models, enhance the viability of existing models, and identify game changing models with the greatest potential to deliver energy access at scale.

7.6 Be creative with business models

The challenge of developing viable and scalable business models for access to energy interventions is one of the most important questions to be addressed. Households typically have low energy demands for meeting basic energy needs. This demand is often not sufficient to make a project commercially viable. At the same time, the lack of avenues to use energy for economic purposes often means that households are unable to pay for continued energy services. The resulting lack of guaranteed inflow of revenue for the project developer and investor leads to projects closing down. Overcoming such problems through business models that ensure risk mitigation against such problems will therefore be key for viable energy access interventions.

Impact investors can play a role in developing and financing innovative business models. One option is to secure anchor load consumption for energy access interventions such as mini-grids. Anchor customers are customers that require a continuous delivery of energy service for productive use, which is also predictable in load and availability. They are typically reliable and credit-worthy customers who are bound to contracts and are therefore, bankable. Using such anchor customers as the main off-taker from a project not only guarantees energy purchase and secures commercial viability of the project, but also provides scope for scaling up the project. Of course, there will be need to ensure equitable benefit sharing of energy between industry and households, and impact investors are well-positioned to do that. Potential anchor customers could include the telecommunications industry, mining companies and agro industries.

Another option is to support enterprise development activities to increase productive use by small industry. It has been seen that interventions such as mini-grids have been publically financed through grants or subsidies in order to cover upfront capital costs. The lack of purchasing power has meant insufficient funding to sustain maintenance over the project lifetime or to finance the replacement of key mini-grid components in the long term and therefore rendered projects unviable. Impact investors can support entrepreneurs to design, develop and implement energy interventions that allow for and encourage the productive use of energy or support the development of microenterprises where energy access interventions are placed. This will not only lead to increased purchasing power of households and communities and enhance their capacity to pay for energy services, but also encourage demand generation to realize the full economic potential of that access.

8. Conclusion

From the foregoing discussion it is clear that much progress has been made to make clean energy more accessible to households, much of it driven by cheaper technologies and a wider acceptance of those technologies.

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Innovative finance models, often coupled with information technology or underpinned by a micro-loan programme have also made it more affordable for end users. By demonstrating demand, technology and the willingness and ability to pay, Companies such as M-Kopa and SunnyMoney have also been successful in leveraging additional finance. Anecdotal evidence also suggests that data demonstrating demand can also be used to reduce the perceived risk to insurers and unlock insurance to cover possible default on the repayment. (Peo, 2018). However, they are the exception rather than the rule.

These innovative business models must be taken to scale by appropriate early stage and growth capital to address the enormous energy needs of Africa. Now that it has been demonstrated that Africans should not be doomed to use woodfuels and kerosene for their household needs, governments and investors should join hands, to take one step up the energy ladder, using appropriate policies to use RE technology to kick-start small scale enterprises that can support sustainable livelihoods and sustainability. Increased economic activity will substantially lower the risk to investors and thus increase the attractiveness of the market.

This is where impact investing can play a valuable role: promote and finance the development and maturation of sustainable business models throughout the energy value chain for energy access. Impact investment can be the important vehicle that has direct immediate social impact with magnified long term development outcomes while ultimately catalyzing commercial capital to truly scale the delivery of sustainable business models to achieve energy access at scale.

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