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Solar Energy in East Africa – Opportunities, Challenges and the Impact of COVID-19

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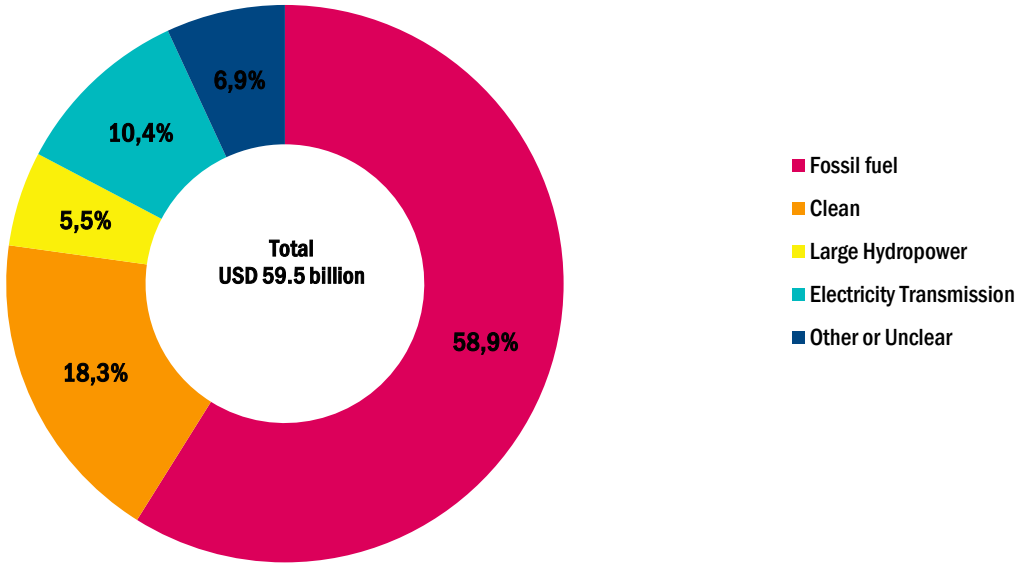
The outbreak of the novel corona virus disease has impacted renewable energy in Africa. Although much of the world is experiencing reduced energy demand due to on-going lockdown measures which has resulted in unstable oil prices and traditional logic suggests that low oil prices can make renewable energy less competitive.
However, African Governments and relevant stakeholders are recognising the important role renewable energy (and in particular solar energy) can play in fighting the pandemic and in assisting businesses to stay afloat following this disruption.

Drivers for Renewable Energy in East Africa

According to the International Energy Agency, an estimated 620 million people in Africa do not have access to electricity representing about two thirds of the continent's approximately 1 billion population[1]. In East Africa, less than a quarter of the population has electricity access- one of the lowest electrification rates in the world[2]. In Africa, power is generated largely by old fossil fuel plants and/or gas sources. In 2012, approximately 65% of the total energy production was generated from coal and/or gas sources[3]. Similarly, the majority (approximately 60%) of international public finance for Africa's energy generation was channeled towards the fossil fuel industry between2014 and 2016. East Africa is no exception: both national and international efforts to increase electricity generation capacity in the region have traditionally concentrated on the expansion of natural gas, coal and large hydro power[4]. As the population of East Africa continues to grow, there is a need to increase the supply of electricity generation.

Whilst it has historically been cheaper and easier for Africa to meet energy generation through biomass (e. g. burning wood for cooking), gas and large hydropower, such sources of energy are not sustainable and contribute pollution in some cases. Although Africa currently contributes little to global emissions associated with climate change, there are many compelling reasons why Africa should switch to renewable energy. The most compelling reason is the fact that the effects of climate change are likely to be more severe in Africa given its high dependency on agriculture as well as its limited capacity to adapt to climate change[5].

Public finance for Africa's energy sector, 2014 to 2016



Adapted from: Assessing International Public Finance for Energy in Africa. Oil Change International, 2018 http://priceofoil.org/content/uploads/2018/07/africa_finance_report_final_web.pdf (Accessed on 30.12.2020)

[1] International Energy Agency, "Africa Energy Outlook," OECD/IEA, Paris, 2014.
[2] Gordon E., "The Politics of Renewable Energy in East Africa", Oxford Institute of Energy Studies, 2018
[3] Unlocking Solar Capital Africa 'Facts and Figures: Solar Energy in Africa' 2018
[4] Hansen, U.E., Pedersen, M.B. and Nygaard, I, "Review of Solar PV Policies, Interventions and Diffusion in East Africa" 2015
[5] Collier P, Conway G, Venables T. "Climate change and Africa" Oxf Rev Econ Policy 2008

In addition, and aside from climate change motivations, increasing the production of renewable energy is likely to contribute significantly to the achievement of several of the United Nations General Assembly's Sustainable Development Goals. Firstly, an increase in sustainable energy production would likely lead to more productive agriculture and thus contributes to food security[6]. Secondly, solar home systems (SHS) and small scale renewable energy sources are likely to indirectly impact education and therefore promote economic development[7]. Thirdly, renewable energy has the potential of reducing gender inequality; the burden of collecting firewood in rural Africa falls disproportionately on women. Access to renewable energy sources is likely to lead to saved time which can be used for other productive purposes such as paid employment[8]. Finally, renewable energy reduces deforestation which reduces pressure on the forest ecosystems and promotes sustainable forest management[9].

The renewable energy potential in almost all African countries greatly surpasses their current energy generation[10]. According to Krewitt et al "in terms of total renewable electricity potential, Africa is the region that possesses the most abundant renewable energy potential, mainly due to the huge potential for solar technologies"[11]. East Africa in particular has a large potential for solar energy production. The solar power potential of the East African Community (EAC) which comprises Burundi, Kenya, Rwanda, South Sudan, Uganda and Tanzania is estimated at 73.1 trillion kilowatt hours per year using PV technologies[12]. This represents significant solar potential on the continent (although on a country level, South Africa and Sudan have the highest solar potential). Solar energy potential is an approximation by the International Renewable Energy Agency of the total amount of land suitable for solar power production and which could be made available for electricity generation to sell to the national grid. This is determined by a combination of surface area, climate and geographical position.

The current corona virus disease (COVID 19) pandemic has also impacted renewable energy in Africa. Although much of the world is experiencing reduced energy demand due to on-going lockdown measures which has resulted in unstable oil prices and traditional logic suggests that low oil prices can make renewable energy less competitive, Africa also faces unique challenges which may only be addressed by renewable energy.

Although sub-Saharan Africa is facing decreased energy demand along with the rest of the world, the region's on-grid electricity is plagued with persistent power cuts and a majority of the rural population is not connected to the grid. There is a pressing need for reliable electricity in the urban health care sector and for extension of energy access to rural areas to ensure that rural healthcare services are properly equipped to deal with the pandemic. Energy services are key to fighting the pandemic from powering healthcare facilities and supplying clean water for basic hygiene to enabling communications.

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[6] Mushtaq S, Maraseni TN, Maroulis J, Hafeez M. "Energy and water trade-offs in enhancing food security: a selective international assessment" Energy Policy 2009

[7] Kirubi C, Jacobson A, Kammen DM, Mills A. "Community-based electric microgrids can contribute to rural development: evidence from Kenya" World Dev 2009

[8] Dinkelman T "The effects of rural electrification on employment: new evidence from South Africa" Am Econ Rev 2011

[9] Odihi J "Deforestation in afforestation priority zone in sudano-sahelian Nigeri" Appl Geogr 2003

[10] Deichmann U, Meisner C, Murray S, Wheeler D. "The economics of renewable energy expansion in rural sub-Saharan Africa" Energy Policy 2011

[11] Krewitt W, Nienhaus K, Kleßmann C, Capone C, Stricker E, Graus W, et al. "Role and potential of renewable energy and energy efficiency for global energy supply" Federal Environment Agency, Dessau-Roßlau, Germany

[12] The International Renewable Energy Agency (IRENA) and Sweden's Royal Institute of Technology (KTH) "Estimating the Renewable Energy Potential in Africa" Working Paper 2014

African Governments and relevant stakeholders are recognizing the important role renewable energy (and in particular solar energy) can play in fighting the pandemic and in assisting businesses to stay afloat following this disruption. In Kenya for example, the Jomo Kenyatta University of Agriculture and Technology unveiled solar powered ventilators and solar powered hand washing machines to aid in the fight against the pandemic.[13]. Similarly, in an effort to assist small and medium sized businesses deal with recurring utility costs despite slowed business, German Pay-As-You-Go (PAYG) solar distributor Redavia has introduced a new concessionary solar program to its clients in Kenya and Ghana.[14]. Under the program, called the COVID-19 Resilience Lease, Redavia will provide solar plants to its business customers for six months completely free. After six months, clients can choose to roll-over the lease into a regular solar plant lease or re-deploy the plant. And finally, the Government in Kenya has designated off-grid solar as an "essential service" with a view to keep the industry going.

Solar Power in East Africa

Currently, PVs are the most common form of solar power generation technology in use and may be distributed via off-grid (stand-alone) systems, distributed and decentralized systems and centralized (utility) scale systems.[15]. Despite the strong potential of solar energy in East Africa, investments in renewables in the region have been predominantly on hydropower and geothermal projects. However, investments in off-grid renewables, particularly solar PV sector are rising.[16]. Global investment in off-grid solar reportedly reached a record USD 276 Million out of which approximately half was raised by companies entering into or expanding their activities in, the EAC region.[17]. Similarly, the mini/micro grid sector is also attracting significant investment. For example, Enel Green Power and Power Hive partnered up to invest USD 12 Million for the construction and operation of mini grids in 100 villages located across Kenya. Traditionally, the main development partners financing renewable energy projects in the EAC region have been the World Bank, the Japanese International Cooperation Agency and the French Development Agency.[18]. However, other development finance institutions have began to play bigger roles.

The literature on the status and potential of solar energy in east Africa has highlighted a number of factors that have contributed to the progress made so far and which areas require further development if the potential of solar energy is to be fully realized. The first factor is the recent and substantial decline in world market prices for PV modules.[19]. There was a decline of about 74% in total installation costs between 2010 and 2018. This reduction in prices has been driven by lower solar PV module prices and on-going reduction in balance-of-system costs.[20]. These costs had been forecasted to decline further by 2050.[21]. Stand-alone PV systems have had the greatest success in the EAC market. The EAC region accounts for about a third of all sales in pico solar systems in Africa with Tanzania and Kenya leading the market for solar lighting products and comprising the largest micro-grid markets.[22]. However, plummeting oil prices and the impact of the

[13] See https://www.kenyanews.go.ke/jkuat-unveils-innovations-to-fight-covid-19/

[14] See https://www.redaviasolar.com/redavia-delivers-free-solar-during-covid-19-crisis/

[15] Quansah D., Adaramola M., and Mensah, L.D "Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential" 2016

[16] United Nations Industrial Development Organization EAC Renewable Energy and Energy Efficiency – Regional Status Report 2016

[17] Ibid

[18] bid

[19] Hansen, U.E., Pedersen, M.B. and Nygaard, I, "Review of Solar PV Policies, Interventions and Diffusion in East Africa" 2015

[20] International Renewable Energy Agency "Future of Solar Photovoltaic" 2019

[21] Ibid

[22] Ibid 12 above

COVID-19 pandemic on manufacturing and logistics are likely to negatively affect the price of solar systems, at least in the short run. China, which is one of the countries heavily impacted by the pandemic, is the main global producer of many clean energy technologies such as solar panels. The COVID-19 pandemic has delayed shipments from China and affected global supply chains generally. However, as China has resumed and ramped up production to normal capacity and with most countries expected to ease lockdown and other restrictions in the next few months, prices are expected to rise temporarily due to depreciation of most local African currencies but expected to be offset by excessive supply against lower demand. A more pressing concern in East Africa currently, is keeping solar businesses afloat particularly those relying on monthly repayments of low-end customers who are already feeling the financial pinch of the pandemic. According to a survey conducted by Sustainable Energy for All of 80 Mini Grid (MG) and Solar Home System companies, on average, off-grid companies expect to lose between 27% (SHS) and 40% (MG) of their revenues in the coming months and 70% of cash off-grid operations having two months or less operating expenses available (67% for MG; 75% for SHS operators)[23]. It is against this background that the global association for the off-grid solar energy industry (GOGLA) is in the process of developing a COVID-19 relief fund to provide emergency funding in the next few months to qualifying businesses.

The second factor is the development of a conducive policy environment. In order to capitalize on the regions potential, EAC partner states developed specific policies and instruments to increase investments in solar power energy. Kenya, Tanzania, Rwanda and Uganda for example have adopted zero-VAT as well as reduced or eliminated import duties on solar devices[24]. In addition, some EAC states have introduced innovative tariff policies on solar products. In 2008, the Kenyan government launched feed-in-tariff policy to support grid connected renewable energy which was in 2010 extended to include solar PV[25]. Similarly, Rwanda introduced its own feed-in-tariff in 2012 which is under revision to provide for a small power project agreement (SPPA) as well as a feed in tariff for solar PV. There has also been an increase in use of renewable energy auctions for larger projects in the EAC region as policymakers seek to procure renewable energy-based electricity at the lowest prices[26]. The use of auctions has contributed to creating market certainty as hitherto lack of clear policies resulted in mixed messages being sent to the private sector[27]. For example, Uganda awarded two contracts for the installation of 20 MW of solar PV systems and Rwanda's 8.5 MW solar project was commissioned following a tender process[28].

The third factor contributing to East Africa solar energy industry growth relates to prolonged support from international donors. International donors have played a particularly significant role in implementing supply side interventions. In Uganda, for example, German Technical Cooperation Agency (GIZ) funded the Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP), in the period 2007-2011. The program was aimed at strengthening the SHS market segment by supporting Kampala- based solar companies with branches or agents in rural areas, local solar dealers as well as micro-finance institutions[29]. Similarly, in Tanzania, the United Nations Environment Programme implemented an initiative entitled 'Transformation of the Rural Photovoltaic Market in Tanzania' with the specific aim of utilizing the private sector as a vehicle for

[23] Sustainable Energy for All, "Identifying Options for Supporting the Off-grid Sector during COVID 19 Crisis – Data presentation from High Level Dialogue" 16 April 2020

[24] United Nations Industrial Development Organization "EAC Renewable Energy and Energy Efficiency – Regional Status Report" 2016

[25] Ministry of Energy Kenya, "Feed-in-tariffs Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity," Ministry of Energy Kenya, Nairobi, 2012

[26] Ibid at 21

[27] Ibid

[28] Ibid

[29] Hansen, U.E., Pedersen, M.B. and Nygaard, I, "Review of Solar PV Policies, Interventions and Diffusion in East Africa" 2015

providing basic services for PV. The program included technical skills training for private sector businesses and establishment of financing mechanisms to provide consumers with access to solar home systems.[30]. Government policy initiatives have been supplemented by donor programs supporting the development of the private solar home systems such as the photovoltaic market transformation initiative (PVMTI) implemented by the World Bank in Kenya. The program provides favourable loans to consumers and suppliers of solar home systems.[31].

The fourth factor is the development of innovative financing and technological models. The emergence of SHS PAYG in East Africa marks remarkable development in the pursuit for renewable energy and rural electrification. According to GOGLA, East Africa is the biggest contributor to the increase in SHS PAYG sales volumes which, in 2019, hit a record breaking USD 1.9 million.[32]. Several providers of SHS PAYG have emerged in East Africa, the most popular of which are M-kopa, BBOXX, Azuri Technologies, Fenix International and Mobisol. It is important to note that solar energy opportunities and uptake in East Africa and Kenya in particular has also been driven by the need for large mobile telephone companies to ensure extended network coverage including areas totally cut off from the central power grid.[33].

The literature review also highlighted a number of challenges that East Africa (and indeed Africa at large) faces in increasing its solar generation capacity. These will be discussed using the common market segments: off-grid systems, on-grid distributed systems and utility scale systems.

Off-grid Solar Challenges

In terms of off-grid systems, the key challenges in most African countries including those in EAC region is up-front cost, increase in low quality/counterfeit products and lack of qualified technicians to install and maintain solar systems.[34]. Whilst significant progress has been made in introducing innovative financing solutions such as PAYG solar products, such products still have an up-front cost. The majority of those that are most in need of solar systems are rural populations that live on less than a dollar a day and are still unable to afford the (on average) USD30 upfront cost. As a result, even though PAYG solar systems are on the whole cheaper than kerosene, rural populations may continue to use kerosene as a result of lack of upfront costs.

A second challenge in East African solar markets is the proliferation of low quality and counterfeit solar products. According to GOGLA this increase in low quality products has reduced consumer demand. Products which do not last create a distrust amongst consumers and may deter interest in solar products.[35].

Thirdly, the solar industries of East Africa lack local technicians with the requisite skill set to install and maintain solar infrastructure.[36].The specific skills required for small-scale PV installations is electricity generation.

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[30] United Nations Environmental Programme, “Tanzania: Transformation of the Rural Photovoltaic Market in Tanzania,” UNEP Success Stories Leads, 2014

[31] Ibid

[32] GOGLA “Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data” July-December, Public Report

[33] Adwek George, Shen Bo-xiong, Moses, Arowo, Paul Ndolo, Chepsaigutt-Chebet, John Shimmon, “Review of Solar Energy Development in Kenya: Opportunities and Challenges’ 2019 Renewable Energy Focus 29

[34] Ibid, Quansah D., Adaramola M., and Mensah, L.D “Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential” 2016

[35] GOGLA “Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data” January-June 2018, Public Report

[36] Ibid

Such work may be done by an electrician with additional solar PV training or by a specialized PV installer[37]. In the countries where renewable energy sectors are more advanced, specific Technical Vocational Education and Training (TVET) courses and certifications are often available. The German Solar Academy was established in Nairobi under a framework of a Public Private Partnership project and offered training to artisans and engineers from Kenya, Tanzania and Rwanda. However, after an initial training phase, the project was discontinued as there was no institutional link to TVET and commercial viability could not be achieved[38]. The Kenya government later enacted the Solar Photovoltaics System Regulations gazetted in September 2012 requiring technical training for the design and installation of solar PV. Solar training has now been integrated into an institutional framework -applications for licensing must me made to the Energy Regulatory Commission which grants licenses according to minimum educational qualifications[39]. However, it is clear that installations and maintenance are still being carried out but by unlicensed or inexperienced technicians in some cases.

On-grid Distributed Solar Challenges

The biggest challenges with decentralised systems are low grid coverage and unreliable grids[40]. With very low electrification rates in the region, this PV application is simply not an option for most of the population who only have access to off grid solutions. Even where grid coverage is available, power outages are persistent. According to the World Bank Enterprise survey, outages in sub-Saharan Africa average 8.3 times in a month and last about 5 hours at a time[41]. Because of the extended downtimes in electricity in African countries, Africa's grids are not always reliable forms of storage[42].

Utility-Scale Solar PV Challenges

A number of key barriers would need to be surmounted before East Africa's power sector can realise the potential contribution of solar PV at the utility scale. The main barriers relate to the technical capacity of grid infrastructure and off-taker credibility of local utilities[43]. The variation in solar resource (i.e. its varied presence during the day and unavailability at night) directly affects power plant output and presents challenges to power plant managers who must keep transmission stable and balanced[44]. African grids, including those of East Africa, are characterized by low or no reserve margins and many countries in Africa must cut power because of inadequate electricity generation. Lack of reserve margins limits the growth of solar PV at the utility scale without storage[45]. Another important barrier to centralized solar PV is the issue of power purchase agreements (PPAs). There have been issues with bankability of PPAs signed by utilities without government guarantees. The insistence of government guarantees by investors stems from the failure by utility

[37] European Union Energy Initiative Partnership Facility - GIZ "Vocational Training for Renewable Energy in Africa -Developing the next generation of energy professionals" 2014

[38] Ibid

[39] Ibid

[40] Quansah D., Adaramola M., and Mensah, L.D "Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential" 2016

[41] World Bank, "Fact Sheet: The World Bank and Energy in Africa" The World Bank Group, 2013

[42] Quansah D., Adaramola M., and Mensah, L.D "Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential" 2016

[43] Ibid

[44] Ibid

[45] Ibid

companies to honour payments to power suppliers.[46]. This is a major barrier to the development of this sector and to the possibility of a transition from government led and largely donor supported investments to private capital despite the continued decline in PV prices.[47].

Overcoming challenges

There a number of policy options can be pursued in order to address some of the challenges highlighted in this paper. In order to tackle sub-standard and counterfeit products on the market, governments should consider establishing strict quality control systems to protect their markets.[48]. National minimum standards could be introduced to increase consumer awareness. Governments could also strengthen technical capacities across value chains at the local level.[49]. Technical capacity is required both to develop and enforce minimum standard and oversee and enforce licensing regulations. Industry could also develop a certification programme for installers and products like the "PV Green Card" quality label program in South Africa.[50]. Governments and local utilities should also consider introducing net metering or embedded generation tariffs as a means to increasing investment in solar PV and other technologies by customers.[51]. Net metering refers to a mechanism by which consumers who have solar PV primarily for their consumption can export any excess energy after self-consumption to the main distribution grid. The mechanism is normally applied to small scale generators operating on renewable energy sources. Net metering has a number of advantages: it improves participation in green energy, empowers consumers who generate their own power and monetizes electricity generated by commercial solar PV systems without the need to install batteries.[52].

Governments can consider a number of policies to spur international investment especially in large solar projects such as favourable tax holidays.[53]. Governments should also review feed in tariffs to be competitive with international rates in order to attract investors. In parallel, there is a need to simplify PPA processes for ease of starting new businesses.[54].

The COVID 19 pandemic has demonstrated the challenges of high import dependence. It presents an opportunity for governments and private sector to develop their own industrial capability and shift to domestic production.

Conclusion

In conclusion, solar power presents a viable potential in East Africa which potential is already beginning to be utilised and expected to continue growing after the Covid-19 pandemic. Furthermore, the renewable energy sector in East Africa presents a vibrant investment environment with promising potential for both small and large solar projects. However, to fully tap into the solar potential of East Africa, key barriers need to be

[46] Ibid
[47] Ibid
[48] Muok, B, Makokha W and Palit D "Financing Electricity in Kenya: What Policies are Required?" Policy Brief 2015
[49] Ibid
[50] https://www.pvgreencard.co.za/
[51] Adwek George, Shen Bo-xiong, Moses, Arowo, Paul Ndolo, Chepsaigutt-Chebet, John Shimmon, "Review of Solar Energy Development in Kenya: Opportunities and Challenges' 2019 Renewable Energy Focus 29
[52] Ibid
[53] Muok, B, Makokha W and Palit D "Financing Electricity in Kenya: What Policies are Required?" Policy Brief 2015
[54] Ibid

addressed. In particular, efforts must be made to extend national grids and strengthen transmission infrastructure with the aim of improving reserve margins of power systems. This would enable integration of utility scale power plants. For distributed and decentralised systems, more policies are required especially those allowing for embedded generation tariffs. Distributed and decentralized systems hold enormous prospects in unlocking the potential of solar energy in Africa and favourable policy environments coupled with an extended and stable grid connectivity is required to unlock the potential.

In order to ensure that potential consumers are not deterred from using SHS products, policies and minimum standards must be implemented to tackle the influx of low quality and counterfeit goods. Measures must also be introduced to ensure that technicians installing and repairing solar systems are properly trained and licensed to ensure good customer satisfaction and ensure that goods are providing value for money. However, off grid systems are interim and transitional solutions in most cases and high-quality electricity beyond basic lighting and cooking is a pe-requisite to growth of enterprises which is much needed in Africa. Unlocking more investment inolar and storage solutions in East Africa will be key to enabling significant growth in these markets

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