COVID 19 AND BEYOND - SOLAR ENERGY IN AFRICA: POWERING RESPONSES, ACCELERATING INCLUSIVE AND SUSTAINABLE DEVELOPMENT

ABSTRACT

The coronavirus disease 2019 (COVID 19) pandemic has led to an unprecedented health and social crisis. The pandemic has been the biggest challenge the world has faced since the Second World War. Beyond the immediate impact on health and society, the pandemic has had a major impact on the energy sector and by implication the global economy which is now on the brink of a recession. Energy access has been crucial in responding to the pandemic from powering healthcare systems to enabling work from home initiatives that are being implemented by employers across the world and enabling online learning for the millions of students that are now out of school. As the number of cases in Africa continue to rise, the issue of access to reliable electricity has taken centre stage. In the midst of erratic power supply or lack power supply altogether, Africa has turned to solar energy to power health centres. Solar energy has already played an important role in driving inclusive and sustainable development in Africa. As countries worldwide begin to contemplate post COVID 19 economic recovery plans, energy has again taken a centre stage on the agenda. The pertinent question has been how countries can transition to renewable energy in light of plummeting oil prices and more specifically, what role renewable energy can play in aiding inclusive and sustainable development post COVID 19. The purpose of this paper is to explore the progress of solar energy in Africa prior to the pandemic, the role that solar energy has played in Africa in responding to the pandemic and how solar energy can aid African countries to recover better post COVID 19. This paper concludes that solar energy can play a critical role in driving post COVID 19 recovery in Africa. However, in order to facilitate this, strong collaboration will be required from African governments, the private sector, the international community and local and international financiers.

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1. Introduction

The coronavirus disease 2019 (COVID 19) global pandemic has brought unprecedented shocks across all aspects of society from stressed healthcare systems, to closure of all non-essential activities, disruption to education and significant reduction in government revenues. The pandemic is having a serious impact on the global economy and a COVID 19-induced global recession is now all but certain. The recession is forecasted to be the worst since World War II. GDP growth is projected to contract by 3% in the world, 1.15% in Africa as a whole and 1.6% in sub-Saharan Africa[1]. The International Monetary Fund forecasts that this contraction will entail a downward turn of 5.4% point on the African continent, 5.2% point in Sub-Saharan Africa and 6.4% point in the world respectively[2]. The pandemic and its impact risks undoing all the progress made towards sustainable development in Africa and beyond.

Until recently, Africa appeared to be relatively untouched by the pandemic in comparison to the rest of the world. However, the number of cases has been rising with the World Health Organisation sounding the alarm at the rapid acceleration of the disease in Africa[3]. There is great fear that African healthcare systems will not be able to cope should the pandemic get any worse. Healthcare systems in most sub-Saharan African countries are plagued with a myriad of challenges one of which is access to reliable electricity. Reliable and affordable energy access is critical to healthcare delivery and therefore a prerequisite to fighting any pandemic. Following the Ebola outbreak in Liberia in 2014-2015, lack of reliable power was cited as one of the key challenges in fighting the outbreak[4]. According to Adair-Rohani et al, one in four healthcare facilities in sub-Saharan Africa have no access to electricity and only 34% have access to reliable electricity[5]. Beyond electricity access in healthcare facilities, the statistics are even more bleak; 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[6]. Access to reliable electricity has proved particularly crucial in responding to the COVID 19 pandemic. Not only is electricity required to power healthcare facilities and life-saving machines, it is necessary to support work from home measures being implemented in many companies and organisations across Africa following lockdown measures, enable online learning for the millions of children that are now out of school and enable cashless payments that are being encouraged to curb the spread of the disease.

Power infrastructure in most sub-Saharan African countries is poor and the region's on-grid electricity is plagued with persistent power cuts and a majority of the rural population are not connected to the grid. COVID 19 has intensified the urgency to expand reliable energy and solar energy has emerged as a preferred solution due to its ability to reach millions of people who are not connected to the grid and those whose electricity is erratic. Remarkable progress has already been made in the solar energy sector in Africa and off grid solar applications are

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[1] IMF (2020), "Sub-Saharan Africa: COVID-19: an unprecedented threat to development" *Washington, DC: International Monetary Fund, Regional Economic Outlook 2020, World economic and financial surveys, April 20.*

[2] Ibid

[3] Aljazeera (2020) "WHO Sounds Alarm at Spread of Coronavirus in Africa" retrievable at https://www.aljazeera.com/news/2020/07/sounds-alarm-spread-coronavirus-africa-200720184812122.html

[4] Cooper C, Fidher, D, Gupta N, McCauley, R, Pessoa-Silva, (2016) "Infection Prevention and Control of the Ebola Outbreak in Liberia, 2014 – 2015: Key Challenges and Successes" *BMC Medicine (2016) 14:2*

[5] Adair-Rohani, H, Zukor, K, Bonjour, S, Wilburn, S, Kuesel, A.C., Hebert, R. and Fletcher, E.R, "Limited Electricity Access in Health Facilities of Sub-Saharan Africa: A Systematic Review of Data on Electricity Access, Sources, and Reliability" *Global Health: Science and Practice, 1(2), pp.249-261*

[6] IEA, "Africa Energy Outlook" *OECD/IEA, Paris, 2014.*

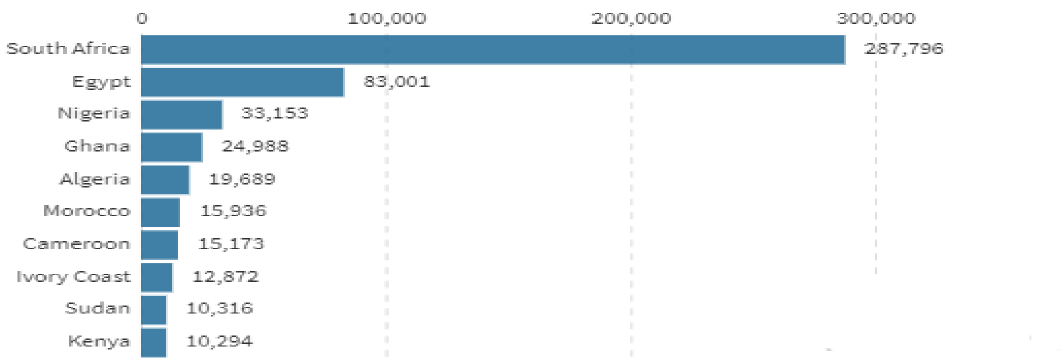
already having a meaningful impact on rural populations. As African governments contemplate easing lockdowns, the question of how to jump start economies has taken centre stage and energy is at the heart of these discussions. As African governments commit funds to recovery, this has created a space for policymakers and other relevant actors to put into place sustainable energy systems. Although solar energy has been impacted by the pandemic along with other renewable energy sources, solar power is expected to recover the quickest[7] and therefore best placed to drive post-COVID 19 recovery efforts.

This paper will proceed as follows: section 2 will give an overview of the COVID 19 pandemic in Africa including African responses to the pandemic. Section 3 will discuss the impact of the COVID 19 pandemic on the global and African energy sectors generally and on the renewable energy sector in particular. Section 4 will review the development of solar energy in Africa prior to the COVID 19 pandemic as well as the drivers for the development and the challenges facing the sector. Section 5 will discuss the role that solar has played during the pandemic. Finally, Section 6 will consider the role that solar energy can play in post COVID 19 recovery and offer policy options that can considered by African governments to promote and stimulate solar energy sector and Section 7 will conclude the paper.

2. Overview of the COVID 19 Pandemic in Africa

The first case of COVID 19 in Africa was confirmed in Egypt on 14th February 2020 and within sub-Sharan Africa, the first case was confirmed in Nigeria on 27th February 2020. As of 18th April 2020, the Africa Centres for Disease Control and Prevention (Africa CDC) reported 19,895 confirmed cases, 4,642 recoveries and 1,017 deaths in Africa, with only two countries on the continent still virus free – Lesotho and the Comoros. Lesotho was the last county in Africa to record a coronavirus case. Figure 1 and 2 below show the worst affected African countries and the distribution of cases per region. Southern Africa has the highest number of cases largely due to the acceleration of the pandemic in South Africa. Similarly, the number of cases in North Africa are driven by the high number of cases in Egypt, Algeria and Morocco.

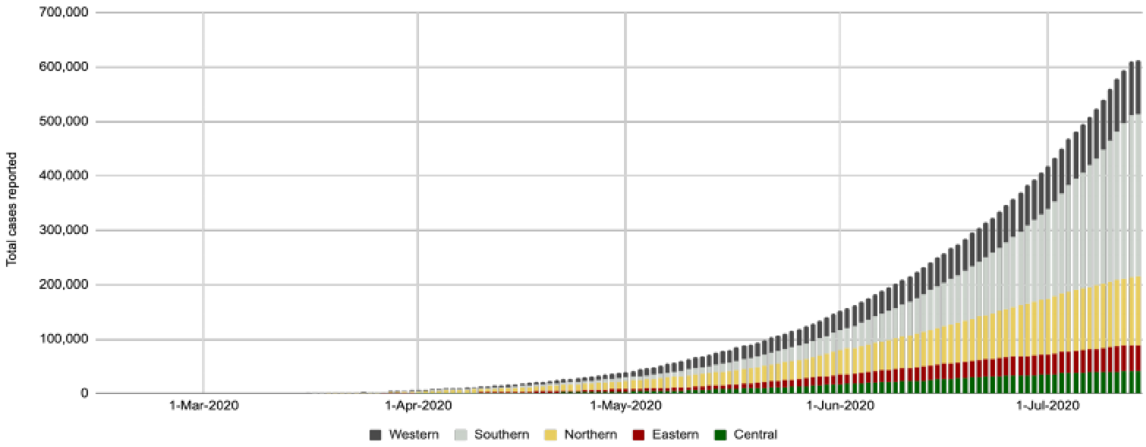
Figure 1. Top 10 African Countries with the highest number of confirmed COVID 19 cases as on 14 July 2020



Source: Africa CDC, 2020

[7] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 crisis on global energy demand and CO2 Emissions" *IEA, April 2020*

Figure 2. Cumulative number of confirmed COVID 19 cases by region for the period 15 February - 14 July 2020



Source: Africa CDC 2020

Although the early cases of COVID 19 in Africa were reported over one month after the first case of the disease was reported in China, giving the region lead time to prepare for a possible outbreak, the initial slow spread of the pandemic in the region fuelled misinformation and myths about the immunity of Africans to COVID 19. However, it soon became clear that overall poor health and underlying health conditions are driving mortality worldwide[8]. As the pandemic accelerated in the United States, stark racial disparities in mortality and morbidity also emerged. Statistics showed that the burden of the pandemic in the United States was most pronounced amongst African Americans who despite comprising only 13% of the population accounted for 30% of the reported cases in the 14 states in which COVID 19 racial statistics were available[9]. A number of explanations have been put forward to explain the disparity including higher incidence of chronic diseases amongst African Americans which leave them predisposed to poor clinical outcomes, underinsurance/lack of insurance, likelihood of living in crowded housing conditions and likelihood of working in essential services[10]. Whatever the exact cause of the observed disparity in morbidity and mortality rates, the implication for African countries was and is clear[11].

To avoid a public health as well as a socio-economic disaster, it was important for African governments to take action against the pandemic and cushion it's people against the impact of pandemic with the assistance of relevant stakeholders. A variety of measures have been introduced by African governments with varying levels of success. All African countries have introduced some form of social distancing measures and the majority have introduced further preventative measures such as information campaigns including those targeted at debunking myths surrounding the disease, promotion of frequent handwashing/sanitization, flight cancellations, school and university closures, bans or restrictions on public gatherings and self-

[8] Ihekweauza, C., and Agogo, E. (2020), "Africa's response to COVID 19" *BMC Med 18, 151 (2020).*

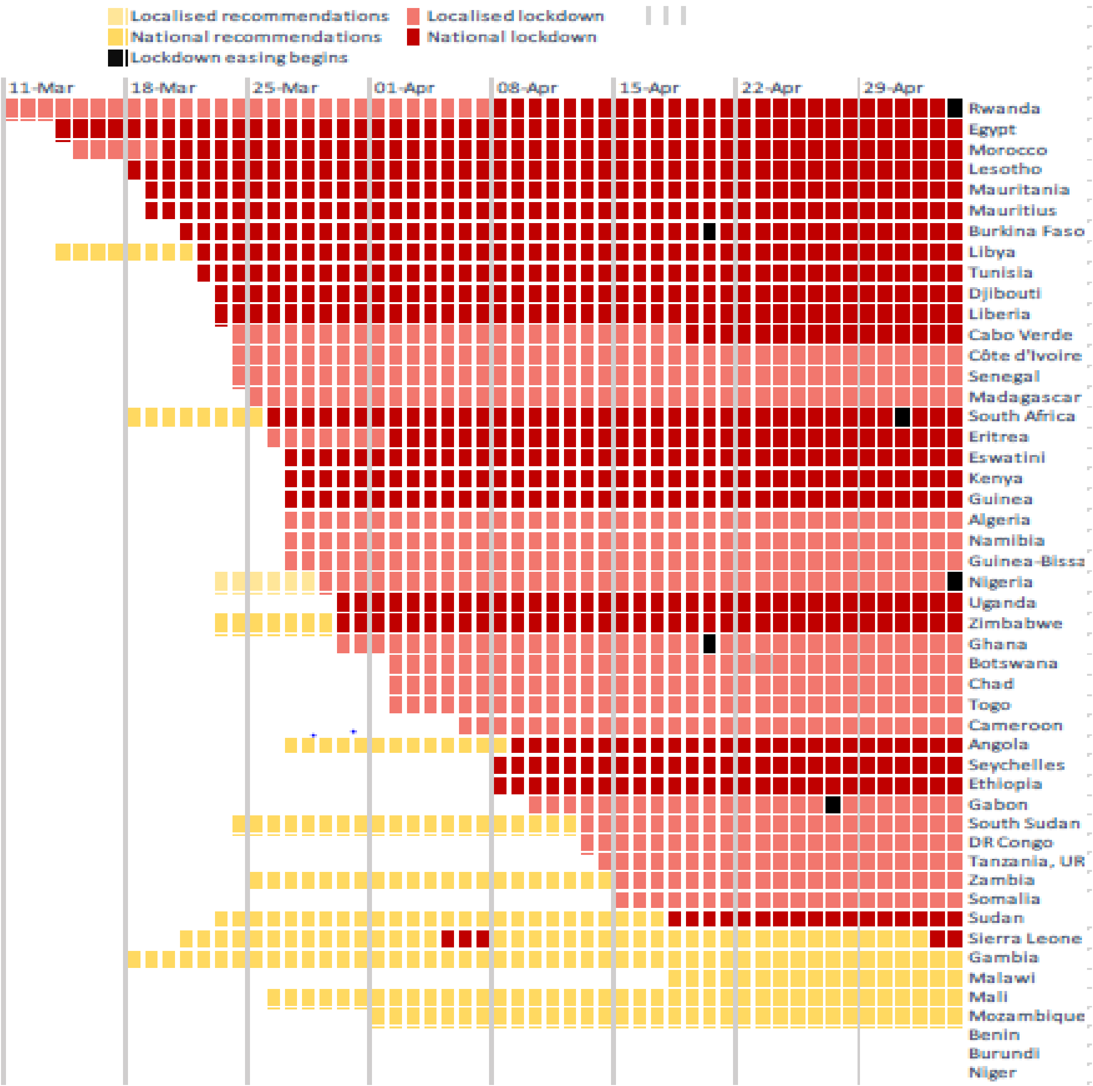
[9] Poteat, T, Millett, GA, Nelson, LRE & Beyrer, C (2020), 'Understanding COVID-19 Risks and Vulnerabilities among Black Communities in America: The Lethal Force of Syndemics', *Annals of Epidemiology*, vol. 47. https://doi.org/10.1016/j.annepidem.2020.05.004

[10] Ibid, Millett, GA, Jones, AT, Benkeser, D, Baral, S, Mercer, L, Beyrer, C, Honermann, B, Lankiewicz, E, Mena, L, Crowley, JS, Sherwood, J & Sullivan, PS. (2020), 'Assessing Differential Impacts of COVID-19 on Black Communities', *Annals of epidemiology*, vol. 47, pp. 37 - 44. https://doi.org/10.1016/j.annepidem.2020.05.003

[11] Ibid at 7

isolation for exposed persons[12]. Some countries such as Uganda, Rwanda and South Africa implemented full lockdowns whilst others such as Kenya, Ghana and Namibia implemented localized lockdowns and in countries like Kenya lockdown measures have been coupled with dawn-to-dusk curfew. Some countries like Burundi and Malawi had not implemented any restrictions to movements withing their borders. Figure 3 below indicates the status of African lockdowns up to end of April 2020.

Figure 3. Graph indicating African lockdowns, by date of application, stringency and geographical coverage as on 4 May 2020



Source: UNECA,2020

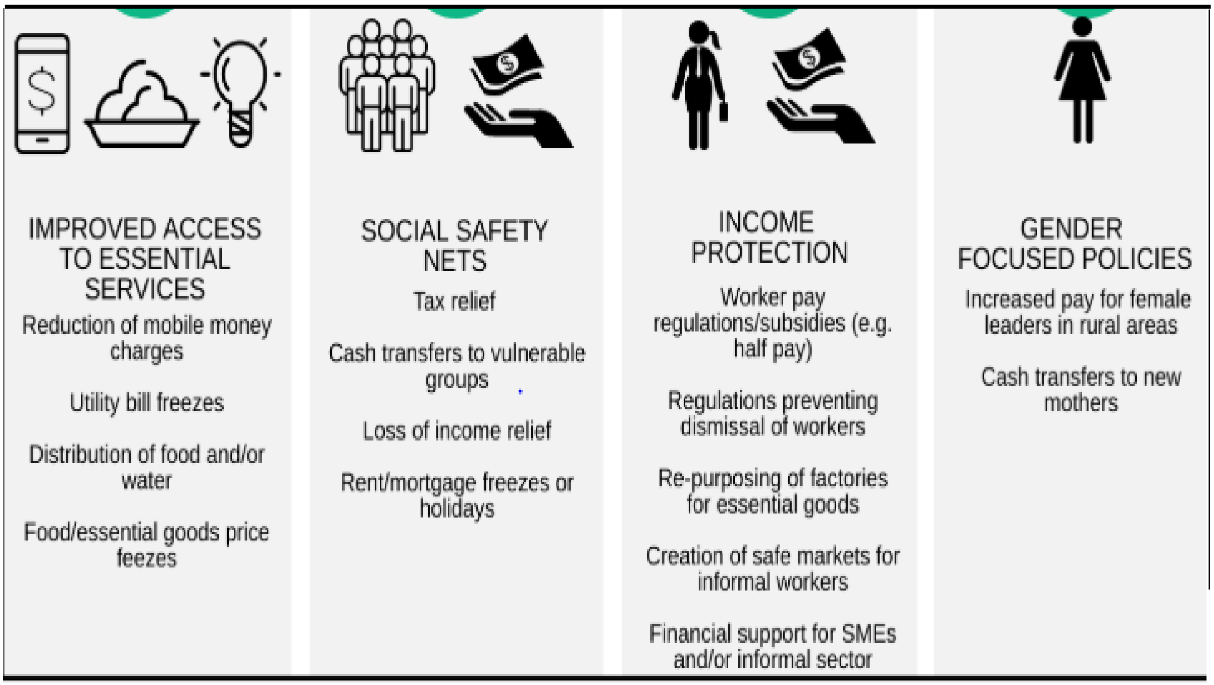
Lockdown and curfew measures have been a highly sensitive subject in Africa due to several socio-economic factors. Firstly, most African countries have a large informal economy comprising up to 85.5% of economic activity in sub-Saharan Africa with the majority of the

[12] Osseni, I.A.(2020) "COVID-19 Pandemic in Sub-Saharan Africa: Preparedness, Response, and Hidden Potentials" Trop Med Health 48, 48 (2020). https://doi.org/10.1186/s41182-020-00240-9, Ryder, H.W, Bonefo, A. (2020) "COVID-19: Impacts on African Economies – Economic Challenges and Social Safety Net Responses" *PEGNet Policy Brief, No. 20/2020, Kiel Institute for the World Economy (IfW), Poverty Reduction, Equity and Growth Network (PEGNet), Kiel*

population in the informal economy living hand to mouth[13]. Secondly, the informal economy is dominated by women and girls who are already disadvantaged in society[14]. Thirdly, social safety nets are usually provided by family members though remittances[15]. If people stop earning, the impact is felt across a large number of extended family. Thirdly, both poor and affluent families in Africa are highly dependant on fresh produce markets which sell food at cheaper cost. In assessing lock down regulations in South Africa which showed bias towards large supermarkets only remaining open, Battersby noted that the regulations demonstrate a limited understanding of how the poor access food[16]. An even bigger challenge is keeping economies afloat and preventing destitution and hunger. The closure of entertainment venues, schools and universities and shut down of public transport has already left millions out of work. Therefore, one of biggest factors in assessing whether African countries can survive total lockdown has been the availability of compensation and support policies both to individuals and businesses in hard hit sectors of the economy.

At the end of April 2020, 44 countries in Africa had compensation and support policies to support the economy and aid the most vulnerable in their countries[17]. Figure 4 shows the types of compensation and support policies that have been introduced and Figure 5 shows the number of countries using each economic/policy tool.

Figure 4.Types of COVID 19 compensation and support policies in Africa



Source: Development Reimagined

[13] ILO, (2020), "The Impact of COVID-19 on the Informal Economy in Africa and the Related Policy Responses" International Labour Organisation Briefing Note, 2020. https://www.ilo.org/africa/information-resources/publications/WCMS_741864/lang--en/index.htm

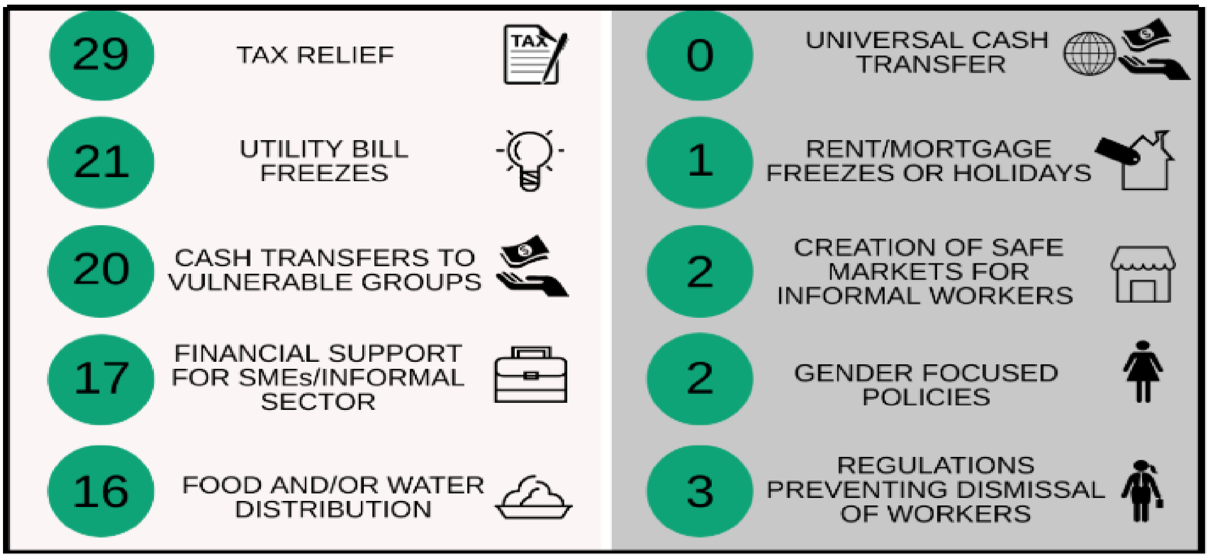
[14] Ibid

[15] Ibid

[16] Battersby, J. (2020) "South Africa's Lockdown Regulations and The Reinforcement of Anti-Informality Bias" *Agric Hum Values 37, 543–544 (2020).* https://doi.org/10.1007/s10460-020-10078-w

[17] Ryder, H.W, Bonefo, A. (2020) "COVID-19: Impacts on African Economies – Economic Challenges and Social Safety Net Responses" *PEGNet Policy Brief, No. 20/2020, Kiel Institute for the World Economy (IfW), Poverty Reduction, Equity and Growth Network (PEGNet), Kiel*

Figure 5. Number of African countries using each policy tool



Source: Development Reimagined

These measures have had major costs on African economies. Of these, 36 African countries have allocated a specific budget to fund the measures as well as other related healthcare costs. It is reported that on average each country is spending 1% of their GDP to respond to COVID19 – budgets that together add up to US$37.8 Billion[18]. As a result, no African country has introduced universal cash transfer to date.

It was recognised that even with the best preventative measures in place, early detection and treatment is the best way to control the spread of the virus and several African countries have taken the lead[19]. For example, Nigeria was the first African country to sequence the SARS-CoV-2 genome[20]. Ghana produced a low cost US$1 COVID 19 antibody test and pioneered pooled testing of samples to hasten test processing time and population coverage[21]. South Africa is leading the continent in testing per capital at 37,485 tests per million people as of 1st July 2020[22]. To enable efficient tracking of COVID exposed persons and treatment of persons who test positive for COVID 19, a number of countries have come up with innovative technologies to aid the enormous task of contact tracing, provide equipment to, and alleviate the workload of, healthcare workers. In Nigeria, Mobile Location Data was introduced to trail the movement of exposed persons and their contacts. Similar initiatives were introduced in Ethiopia and Benin and in Kenya a contact tracing app was introduced[23]. In Kenya, a garment

[18] Ibid

[19] Osseni, I.A.(2020). "COVID-19 Pandemic in Sub-Saharan Africa: Preparedness, Response, and Hidden Potentials" Trop Med Health 48, 48 (2020). https://doi.org/10.1186/s41182-020-00240-9

[20] https://nef.org/learning-from-the-best-evaluating-covid-19-responses-and-what-africa-can-learn/

[21] Sangeet, J., Chadha, M., Owino, K and Mutua, J., (2020). "The Day After Tomorrow : Africa's Battle with COVID 29 and the Road Ahead" *Observer Research Foundation 31 July 2020* https://www.orfonline.org/research/the-day-after-tomorrow-africas-battle-with-covid19/

[22] Brookings Institute (2020) "Learning from the Best: Evaluating Africa's COVID 19 Responses" retrieved from https://www.brookings.edu/blog/africa-in-focus/2020/07/08/learning-from-the-best-evaluating-africas-covid-19-responses/

[23] ITWeb (2020) "Kenya Launches KoviTrace App to Curb COVID 19" retrieved at https://itweb.africa/content/mQwkoq6PgWk73r9A

factory transformed into a surgical mask manufacturer overnight[24]. In Senegal and Rwanda, robots are being used to screen and monitor patients and Ghana and Rwanda, drones are being utilised to deliver samples to testing sights[25].

Finally, in an effort come up with a coordinated African COVID 19 response, the Africa Centres for Disease Control and Prevention (Africa CDC) and the Southern Africa Center for Infectious Disease Surveillance (SACIDS) have agreed to collaborate on preparing and responding to the pandemic[26]. The collaboration is a response to the to the agreement reached by Africa Health Ministers during a meeting convened by the Chairperson of the African Union Commission, H.E. Moussa Faki Mahamat, in Addis Ababa, Ethiopia, on 22 February 2020. The meeting endorsed a continent-wide strategy for the pandemic to be implemented by the Taskforce on Coronavirus Preparedness and Response (AFTCOR)[27]. The partnership between Africa CDC and SACIDS will prioritise diagnosis and surveillance in selected African Union Member States considered to be at highest risk of the pandemic. It will leverage existing systems for monitoring influenza-like illnesses and severe acute respiratory infections. The two institutions will implement joint activities within the surveillance and laboratory working groups of AFTCOR[28].

3. Impact of COVID 19 on the Energy Sector

3.1. Impact of COVID 19 on the Non- Renewable Global and African Energy Sectors

The ongoing lockdown and travel restriction measures have resulted in slowed transport, trade and economic activity and this has had a severe impact on the energy sector. According to the International Energy Agency (IEA) 2020 Energy Review, road transport dropped by between 50 -75% and aviation activity has come to a halt in some regions and declined more than 90% in some European countries[29]. As a result, global energy demand is estimated to have declined by 3.8% in the first quarter of 2020 with much of the impact being felt in March as movement restrictions were enforced in Europe, North America and Asia[30]. Assuming that lockdowns last for several months and that lifting of lockdown measures is slow and gradual, the IEA estimates that global energy demand could fall by 6% this year overall, five times what was lost during the 2008 financial crisis[31].

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[24] Brookings Institute (2020) "Learning from the Best: Evaluating Africa's COVID 19 Responses" retrieved from https://www.brookings.edu/blog/africa-in-focus/2020/07/08/learning-from-the-best-evaluating-africas-covid-19-responses/

[25] Ibid

[26] Africa CDC (2020) "Africa CDC Partners with SACIDS on COVID -19 Preparedness and Response" retrieved at https://africacdc.org/news-item/africa-cdc-partners-with-sacids-on-covid-19-preparedness-and-response/

[27] AU, Africa CDC, (2020). "Africa Joint Continental Strategy for COVID 19 Outbreak" *African Union; Africa CDC Centres for Disease Control and Prevention, 2020*

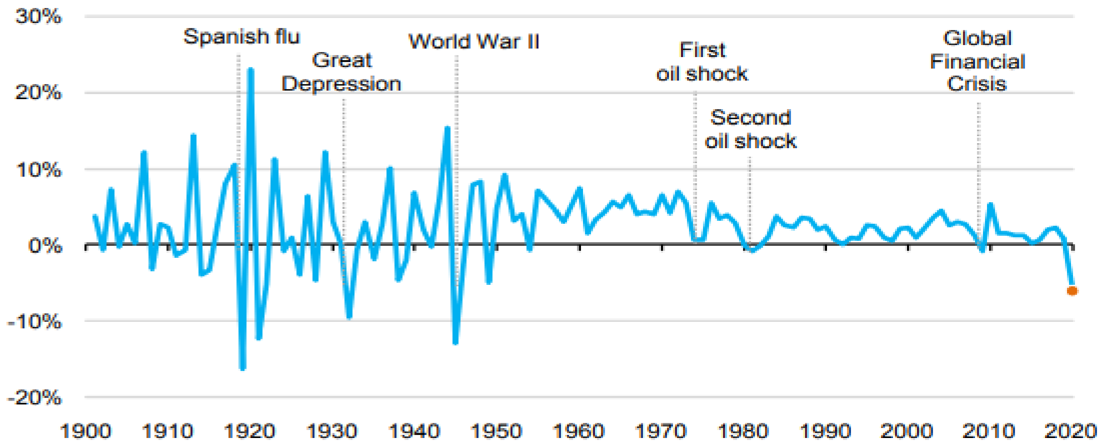
[28] Ibid

[29] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 crisis on global energy demand and CO2 Emissions" *IEA, April 2020*

[30] Ibid

[31] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions" *IEA, April 2020*

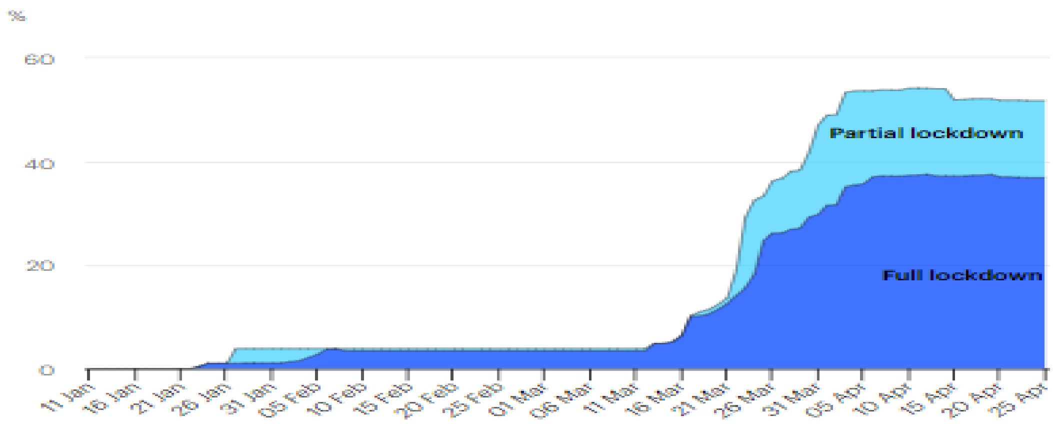
Figure 6. Rate of Change on Global Primary Energy Demand, 1900 - 2020



Source: IEA, 2020

The review found that countries in total lockdown are experiencing a 25% decline in energy demand on average whilst those in partial lockdown are experiencing a 18% decline on average[32]. Figure 7 below illustrates the share of global primary energy demand affected by mandatory lockdowns from January to April 2020 with a marked increase between March and April 2020.

Figure 7. Share of global primary energy demand affected by mandatory lockdowns, January - April 2020



Source: IEA, 2020

In the first quarter of 2020, global coal demand was hit the hardest as a result of restrictions on economic activity and changes in weather. Global coal demand fell by approximately 8%[33]. The decline was caused primarily by the power sector as a result of reductions in electricity demand as well as competition from very cheap oil. Global electricity demand declined by 2.5% in the first quarter of 2020 with total lockdown measures responsible for at least 15%

[32] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions" *IEA, April 2020*

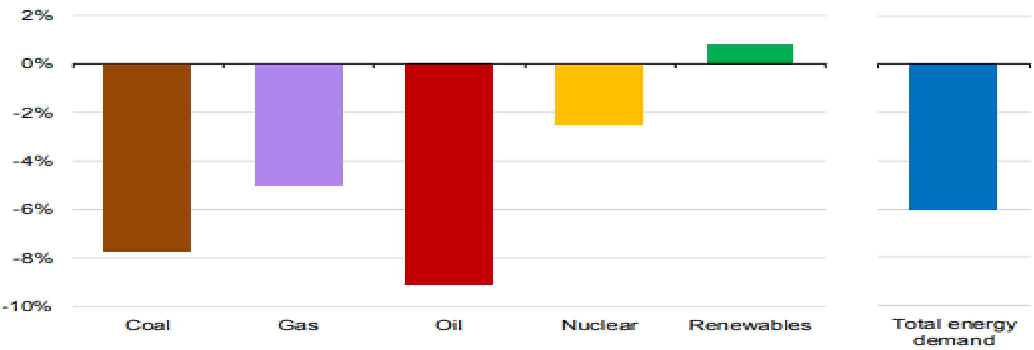
[33] Ibid

daily reduction in demand in Italy, Spain, the United Kingdom and the United States[34]. The reduction in industrial production also has a noticeable impact on coal demand.

Global oil demand declined by approximately 5% in the first quarter of 2020 largely as a result of slowed mobility and aviation which accounts for 60% of global oil demand[35]. In March alone, oil demand declined by a record 10.8 mb/d year-on-year. Crude oil prices fell by 39.6% in March and a further 34.8% in April month on month, to $21 per barrel[36]. Jet fuel was the fuel product with the largest drop in demand relative 2019 whilst gasoline was the product with the largest absolute drop in demand declining by around 2% in the first quarter of 2020[37]. Nuclear power demand also declined in the first quarter of 2020 as electricity demand fell particularly in Europe and the United States[38]. As a result of the containment measures and resulting decline in energy demand, global CO2 emissions were over 5% lower in the first quarter of 2020 compared to the first quarter of 2019[39]. The reduction on emissions was mainly due to an 8% decline in emissions from coal, 4.5% from oil and 2.3% from natural gas. Overall, CO2 emissions decreased more than energy demand, as the most carbon-intensive fuels experienced the steepest declines in demand during the first quarter of 2020[40].

Renewable energy is the only energy source to have experienced growth in the first quarter of 2020 which growth was driven by output of new wind and solar projects that were completed in 2019[41]. In addition, renewables receive priority on national grids and are not requested to adjust output to match demand and as a result the share of renewables in the electricity generation mix rose significantly by about 1.5% in the first quarter of 2020[42]. In terms on full year projections for 2020, all fuels other than renewables are expected to experience their greatest contractions in demand in decades. The IEA estimates that in some cases, the annual declines will be stronger than those experienced in the first of 2020[43]. The below graph shows the projected change in primary energy demand by fuel type in 2020 relative 2020.

Figure 8. Projected Change in Primary Energy Demand by Fuel in 2020 Relative to 2019

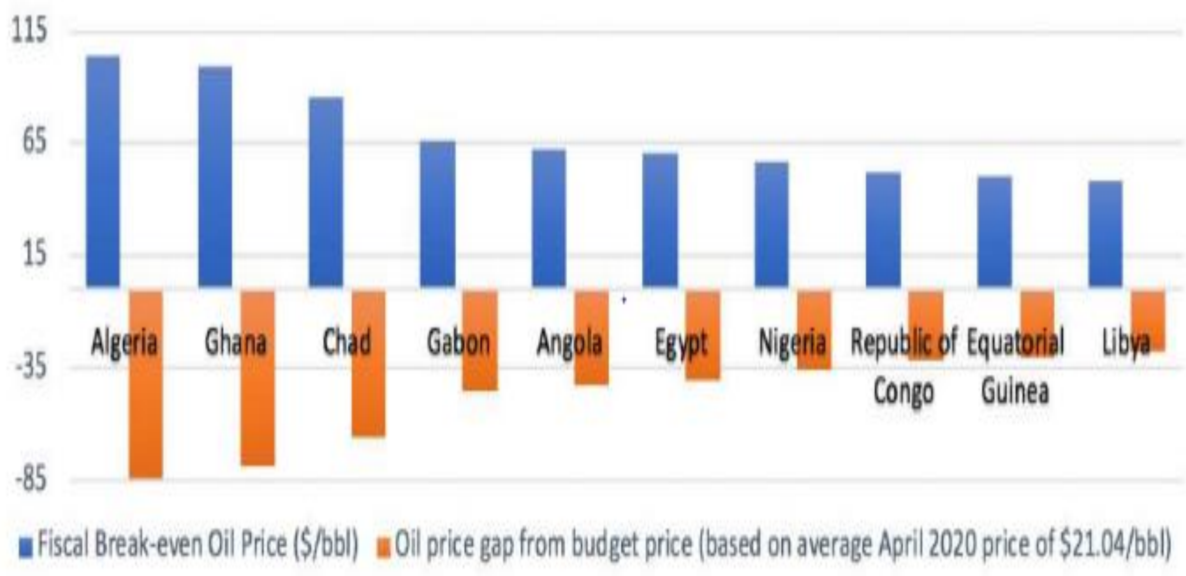


Source: IEA, 2020

[34] Ibid
[35] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions" *IEA, April 2020*
[36] World Bank (2020), "World Bank Commodities Price Data (The Pink Sheet)" *World Bank Group, 2020*
[37] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 crisis on global energy demand and CO2 Emissions" *IEA, April 2020*
[38] Ibid
[39] Ibid
[40] Ibid
[41] Ibid
[42] Ibid
[43] Ibid

In Africa, like in the rest of the world, the transport sector and the aviation industry in particular has been very heavily hit. The International Air Travel Association estimates that air traffic in Africa will decrease by 51% in 2020[44]. Other impacts on the African energy sector include declining exports of energy resources and disruptions in the construction of new energy projects[45]. China depends heavily on Africa for iron ore, lithium, copper, and cobalt. COVID-19-induced lockdowns have reduced demand for these minerals[46]. Oil and gas producing African countries (particularly those of North Africa) are also suffering from the global decline in demand, and fall in oil prices which has caused fiscal distress in these countries as evidenced by the graph below.

Figure 9. Fiscal Distress in Africa's Oil Exporting Countries



Source: RES4Africa, UNECA, 2020

The impact of COVID 19 on African electricity sector has been mixed. Severe decline in heavy fuel prices has reduced electricity generation costs in countries with a high share of thermal generation[47]. However, it is noted that due to regulations, consumers are likely to benefit from this[48]. Similarly, African countries dependent on coal and natural gas for baseload electricity generation have the opportunity to benefit from the decline in prices where prices are not locked by existing contracts (though not to the same extent as electricity system whose generations is based on heavy fuels)[49]. The below figure demonstrates the share of coal and natural gas in the electricity supply of the number of African countries and their prices.

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[44] IATA (2020). "Aviation Relief for African Airlines Critical as COVID-19 Impacts Deepen" *Pressroom, 2020.*

[45] RES4Africa Foundation & UNEC. (2020). "The impact of COVID-19 on Africa's energy sector and the role of RE to empower a long term sustainable recovery" https://www.res4africa.org/wpcontent/uploads/2020/06/RES4Africa-Foundation-The-impact-of-Covid-19-on-Africas-energy-sectorweb.pdf

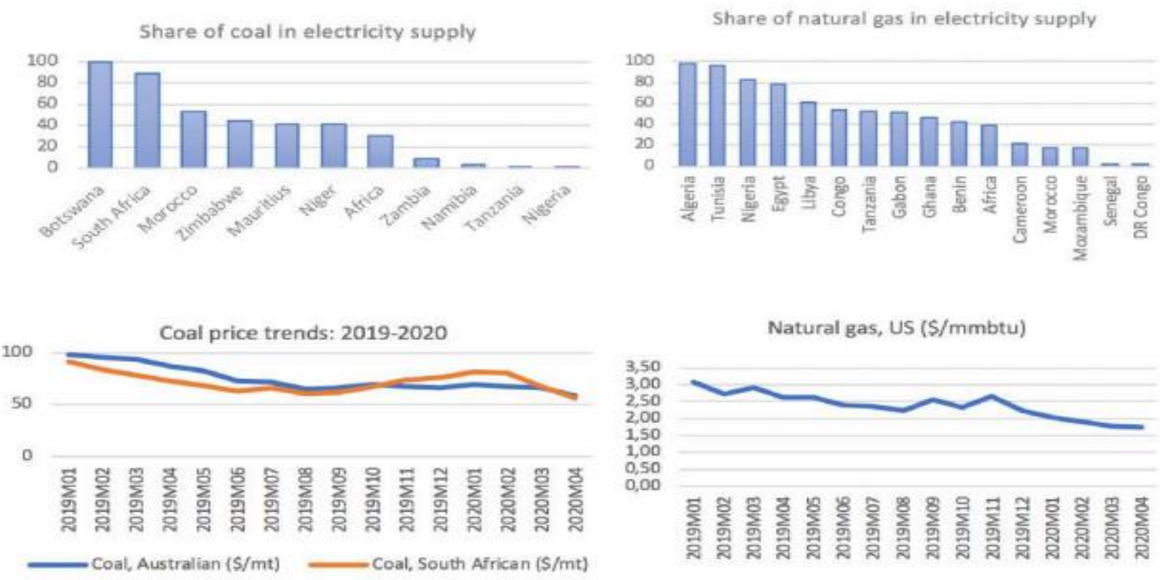
[46] Ibid

[47] Ibid

[48] Ibid

[49] Ibid

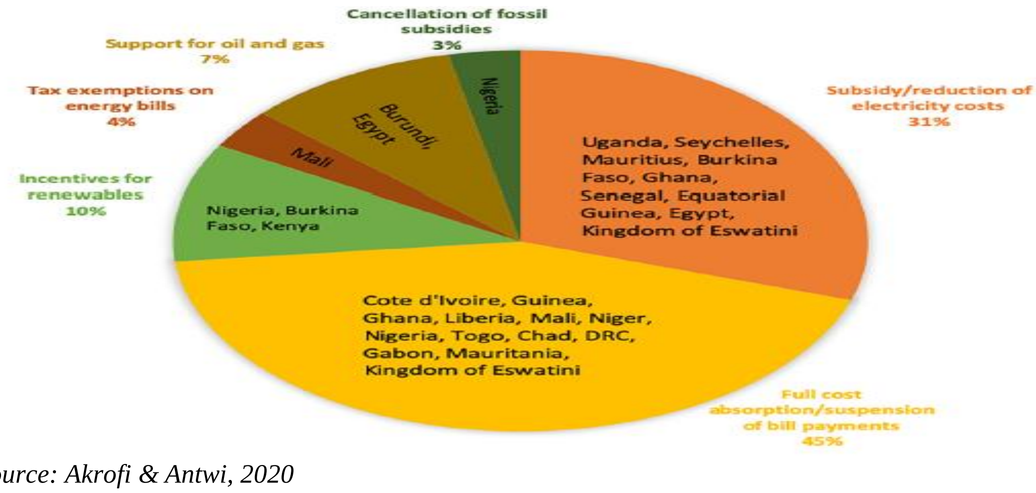
Figure 10. Share of Coal and Natural Gas in Electricity Supply and their Prices



Source: RES4Africa, UNECA, 2020

Governments in Africa are taking measures to support the energy sector and to mitigate the negative effects of the pandemic[50]. These measures include absorbing the cost of electricity during the lockdown periods, allowing customers to delay the payment of their utility bills, waiving interest rates or tax, placing bans on electricity disconnections, restricting regular maintenance activities and postponing or suspending planned electricity interruptions to ensure reliable power supply during the pandemic[51]. The below chart demonstrated the range of energy responses in a number of African countries.

Figure 11. Immediate Energy Sector COVID-19 Responses in Africa



Source: Akrofi & Antwi, 2020

[50] Akrofi M.M., and Antwi S.H. (2020). "COVID-19 Energy Sector Responses In Africa: A Review Of Preliminary Government Interventions" Energy Res Soc Sci. 2020; 68:101681.doi:10.1016/j.erss.2020.101681, Gebreslassie M.G., (2020) "COVID-19 and Energy Access: an Opportunity Or A Challenge For The African Continent?" Energy Res Soc Sci. 2020;68:101677. doi:10.1016/j.erss.2020.101677

[51] Akrofi M.M., and Antwi S.H. (2020). "COVID-19 Energy Sector Responses In Africa: A Review Of Preliminary Government Interventions" Energy Res Soc Sci. 2020; 68:101681.doi:10.1016/j.erss.2020.101681

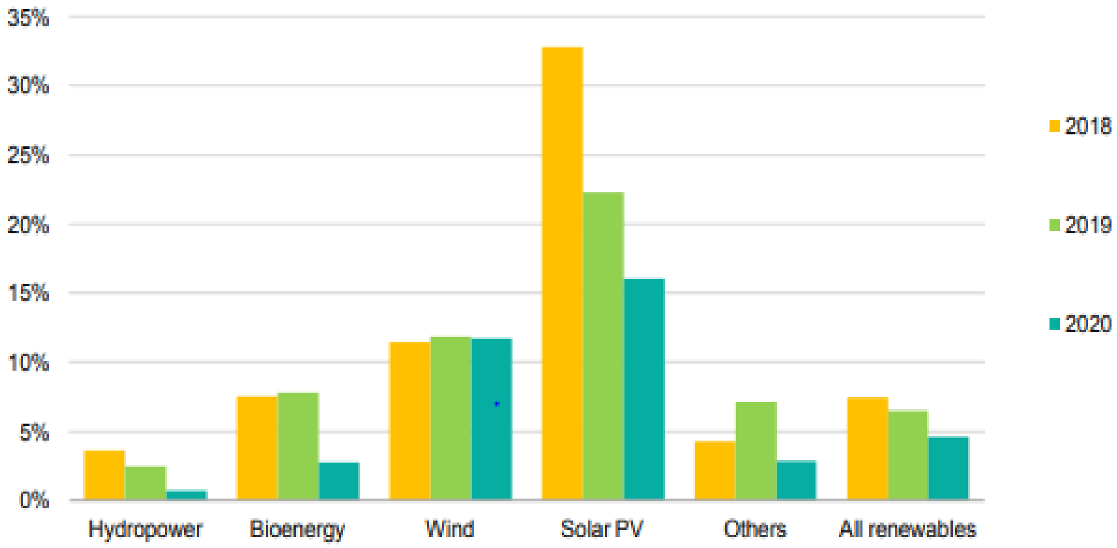
The implications of the measures being employed by African governments is something that will only be understood over time. The consequences of the pandemic for the global and African energy sectors is still evolving and is difficult to predict[52].

3.2. Impact of COVID 19 on the Renewable Energy Sector

As previously discussed, renewable energy has proved to be the most resilient source. This has been due to a rise of about 3% in renewable electricity generation after more 100GW of solar PV and about 60GW of wind projects were completed in 2019[53]. The resilience of renewable energy to lower electricity demand is further aided by the fact that renewables are generally dispatched before other sources of energy due to their low operations costs and favourable regulations that accord them priority[54]. However, the sector has still impacted significantly by the pandemic. China, which is the leading global producer and supplier of renewable energy technologies especially for solar PV, was one of the countries hardest hit by the pandemic. In February, solar PV manufacturing facilities in China ceased or reduced production as a result of COVID 19 related lockdowns in several key provinces[55]. Manufacturing facilities in Europe -which is a major manufacturing hub for wind turbines – experienced disruptions in supply of parts coming in from China and manufacturing facilities in hard hit countries such as Italy and Spain shut following strict contained measures[56]. In addition, introduction of confinement measures which required closure of non-essential facilities (which include wind turbine and solar PV components) until mid-April. In the United States, the impact of these developments have already been evidence with multiple projects receiving force majeure notice from suppliers[57]. Furthermore, restriction of movement of non-essential workers in Europe, India and some states has caused delay in construction activity on renewable projects. Again, as a result of closure of some government agencies, several stages of project development such as securing permits and acquiring land rights have been delayed[58]. Despite the disruptions, the IEA estimates that global use of renewable energy will increase by about 1% in 2020[59]. Solar PV is projected to increase the fastest of all renewable energy sources in 2020 as per below graph.

[52] Ibid
[53] IEA, (2020) "Global Energy Review 2020 – The Impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions" *IEA, April 2020*
[54] Ibid
[55] Ibid
[56] Ibid
[57] Ibid
[58] Ibid
[59] Ibid

Figure 12. Annual Growth for Renewable Generation by Source, 2018-2020



Source: IEA, 2020

In 2019, about one-fifth of all renewable capacity deployed globally consisted of solar PV panels installed by individuals and small-to-medium-sized enterprises installing on their roofs or on their business sites. As a result of the disruption of supply chains discussed above, the installation of distributed solar PV has dramatically reduced in most countries in including in African countries. Havenhill Synergy, a clean technology utility company based in Nigeria, for example, reported that due movement restrictions and closure of ports, off-grid energy developers are facing significant challenges in obtaining equipment and are unable to access project sites[60]. This has delayed a number of renewable energy projects in the county. A number of solar energy projects have been affected in Africa, notably the construction of the floating solar power plant in Seychelles which construction was scheduled to begin in early 2020[61]. Solar companies are also feeling the pinch caused by COVID 19 measures. According to a survey conducted by Sustainable Energy for All of 80 Mini Grid and Solar Home System companies, on average, off-grid companies expect to lose between 27% (SHS) and 40% (mini grid) of their revenues in the coming months and 70% of cash off-grid operations having two months or less operating expenses available (67% for mini grid; 75% for SHS operators)[62]. It is against this background that GOGLA is in the process of developing a COVID 19 relief fund to provide emergency funding in the next few months to qualifying businesses[63]. Finally, in an effort to keep the industry going, some governments (for example, Zambia and Kenya) have

[60] Havenhill Synergy,(2020) "The impact of COVID-19 on the Off-Grid Energy Sector" Sun-Connect-News, 2020. https://www.sun-connect-news.org/articles/market/details/the-impact-of-covid-19-on-the-off-grid-energy-sector/

[61] Construction Review Online (2020) "Construction of Floating Solar Power Plant in Seychelles due to COVID 19" retrieved at https://constructionreviewonline.com/2020/07/construction-of-floating-solar-power-plant-in-seychelles-delayed-due-to-covid-19/

[62] 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*

[63] GOGLA (2020) " COVID – 19: How GOGLA is helping the Off-Grid Solar Industry deal with the crisis" retrievable at https://www.gogla.org/about-us/blogs/covid-19-how-gogla-is-helping-the-off-grid-solar-industry-deal-with-the-crisis

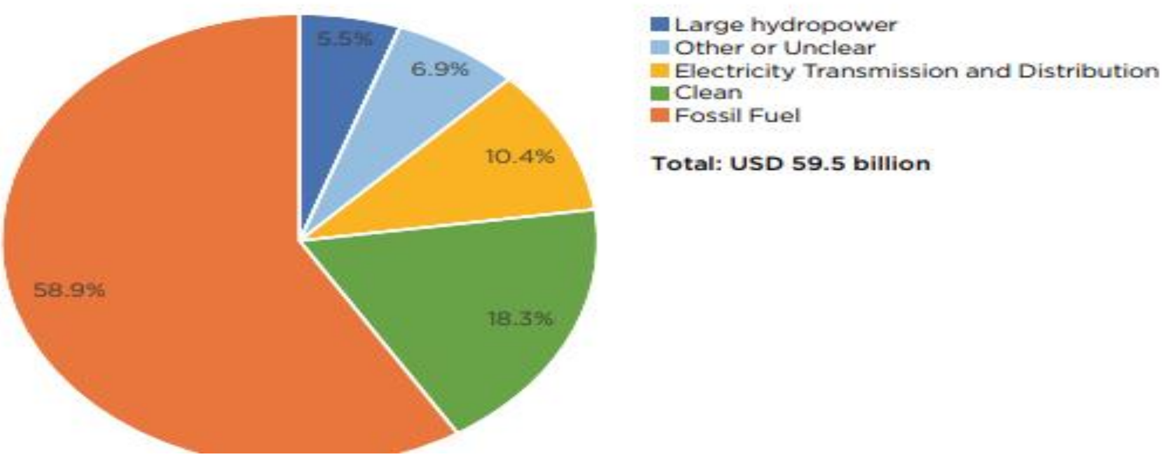
designated off-grid solar as an "essential service". The situation affecting solar and other renewables will depend on the duration of confinement measures and the scope as well as timing of stimulus packages.

4. Solar Power in Africa Prior To COVID 19

4.1. Introduction

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[64]. Similarly, the majority (approximately 60%) of international public finance for Africa's energy generation was channelled towards the fossil fuel industry between 2014 and 2016[65]. Apart from their highly unsustainable nature, these sources of fuel have been very costly for both African governments and consumers alike and have prompted governments to seeks alternatives.

Figure 13. Total Public Finance for Africa's Energy Sector, 2014 - 2016



Source: Oil Change International, 2018

The renewable energy potential in almost all African countries greatly surpasses their current energy generation and the renewable energy potential in Africa has long been recognised. 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*"[66]. Whilst hydropower has historically accounted for the majority of installed renewable power capacity, accounting for approximately 75% of renewables, solar power has become a fast-growing source of renewable energy[67]. Sub-Saharan Africa has the highest irradiation levels in the world experiencing levels of up to 2000 kWh/m2/year which provides for great potential for solar energy applications[68]. There are two main types of solar energy technologies: photovoltaics (PV) and solar thermal. PV devices generate electricity

[64] Unlocking Solar Capital Africa 'Facts and Figures: Solar Energy in Africa' *2018*
[65] Lee, A. and Doukas, A. "Assessing International Public Finance for Africa: Where do Development and Climate Priorities Stand?" *Oil Change International, July 2018*
[66] 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*
[67] Ibid
[68] Unlocking Solar Capital Africa (2018), "Facts and Figures: Solar Energy Africa" 2018

directly from the sunlight using a technology based on photovoltaic effect. Solar thermal or concentrating solar power (CSP) uses mirrors to concentrate the sun's energy to power traditional steam turbines and or engines that create electricity.

4.2. Solar Energy Developments in Africa

The world solar market is dominated by PV. Africa's share of world PV market remains relatively small (particularly considering its high levels of irradiation) representing only 0.7% (5,100 MW out of the global 1.2 GW) of the global market[69]. However, Africa's PV market is growing rapidly. Between 2010 and 2018, solar PV capacity grew five-fold on the continent as per Figure 15. The solar PV market in Africa is dominated by South Africa and Namibia in Southern Africa, Egypt, Morocco and Algeria in North Africa, Kenya in East Africa and Senegal and Ghana in West Africa. Other active markets include La Reunion and Mauritania (Figure 14). Currently, PV is available in Africa under all application modes; utility scale, distributed and decentralized and off-grid (stand-alone).

Figure 15. Evolution of the Total Installed PV Capacity per Region in Africa

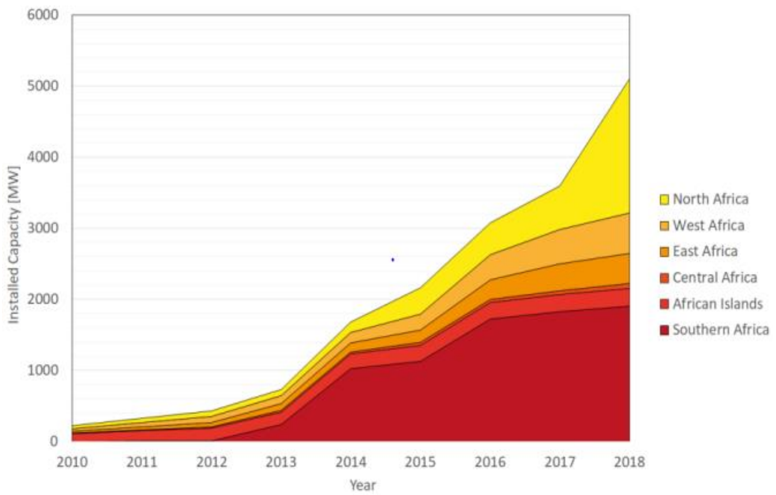
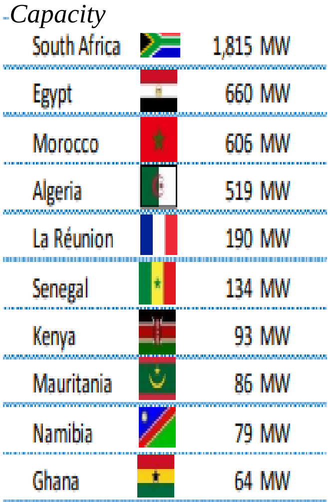


Figure 14. Top 10 African countries with highest Total PV Installed Capacity



Source: German Solar Association, 2019

There have been impressive developments in the utility scale solar segment across Africa with South Africa and Algeria leading the market. South Africa is home to the majority of utility scale power plants in Africa. The largest, Solar Capital De Aar, is located in the Northern Cape and comprises two powerplants with a combined generation capacity of 175MW and is formed on 700,000 solar panels[70]. The project was developed under the South African Government's Renewable Energy Independent Power Producers Procurement Programme (REIPPPP)[71]. In Namibia, a net importer of electricity, the country's largest solar power plant with a generation capacity of 45.5MW was commissioned in 2019. The project was a venture between Alten, state-owned power company NamPower and Namibian solar companies Mangrove, Talyeni

[69] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

[70] Power Technology (2019) "Solar Power in South Africa: A Look at the Country's Solar Plants" retrievable https://www.power-technology.com/features/solar-power-south-africa/

[71] Ibid

and First Place Investment[72]. Algeria has the second highest number of utility scale solar PV plants and dominates the solar PV market in North Africa. The largest solar power plants in Algeria with generation capacities of 90MW each are the High Plateuas East, Adrar and High Plateaus Centre, Adrar[73]. The largest solar power plant in North Africa is located in the Aswan Province in Benban, Egypt. The solar park comprises three power plants with a combined 165.5MW generation capacity[74].

Other regions have also been making progress. In western Senegal, a 30 MW solar PV plant was commissioned in July, 2017. The plant consists of 96,000 solar panels and cost 27 billion CFA (44.8 million USD). This project is one of the largest in West Africa and was connected to the grid in June of 2017[75].A second solar power plant with a generation capacity of 20MW was inaugurated in Senegal in 2018. In 2019, Engie secured Euro 38 Million for two 30MW power plants and entered into long-term power purchase agreements (PPAs) with the national power utility Société d'Electricité du Sénégal[76]. In Ghana, a 20 MW power plant began operation in 2016. The plant is connected to the Electricity Company of Ghana substation in the vicinity[77]. A second 20MW power plant was commissioned in the country in 2018[78].

In 2016, the first utility scale solar PV plant in East Africa was commissioned in Uganda. The 10 MW plant is located in Soroti district in Eastern Uganda and is the largest privately funded solar power plan in sub-Saharan Africa [79]. Power output is sold directly to the country's power distributor, Uganda Electricity Transmission Company Limited (UETCL) for integration to the central grid. It is expected to provide sustainable electricity to some 40,000 homes. In 2019, a second power plant with a generation capacity of 24MW was commissioned in Central Uganda. A twenty-year PPA was concluded with UETCL. In 2019, construction began on the first utility scale power plant in Kenya. The US$ 69 Million 40MW solar PV project is located in Langobay in Malindi district and the electricity will be sold through a twenty-year PPA with the national distribution company Kenya Power and Lighting Company[80]. Two more utility scale projects are in the pipeline which will have a combined generation capacity of 80MW are in the pipeline in Kenya. The project, which is forecasted to cost USD 147 Million, will be part funded by the European Investment Bank, the Nederlandese Dutch Bank FMO NV and Paramount Bank who will each provide USD 53Million loan capital81. The plant is expected to power some 200,000 homes. In addition, Kenya's first-ever floating solar power plant is set to be constructed in the rift valley region. In the islands, a 4MW floating grid-connected

[72] PV Magazine (2019) "Alten to Commission Namibia's Biggest PV Plant" retrievable https://www.pv-magazine.com/2019/06/19/alten-to-commission-namibias-biggest-pv-plant/

[73] Unlocking Solar Capital Africa (2020), "Top 50 Operational Solar Power Plants in Africa" retrievable at https://africa.unlockingsolarcapital.com/top-50-pv-plants

[74] Power Technology (2019) "The Biggest Solar Projects in Africa" retrievable at https://www.power-technology.com/features/the-biggest-solar-projects-in-africa/

[75] Unlocking Solar Capital Africa (2018), "Facts and Figures: Solar Energy Africa" 2018

[76] https://www.pv-magazine.com/2019/07/22/engie-secures-financing-for-60-mw-of-solar-in-senegal/

[77] PV Magazine (2019) "Engie Secures Financing for 60MW of Solar in Senegal" retrievable at https://www.pv-magazine.com/2016/04/15/largest-pv-plant-hooked-up-in-ghana_100024163/

[78] PV Magazine (2018) "Ghana Commissions 20MW Solar Park, Auctions for IPP Projects"https://www.pv-magazine.com/2018/09/17/ghana-comissions-20-mw-solar-park-plans-auctions-for-ipp-projects/

[79] Renewable Energy Focus (2016) "Construction to begin on East Africa's largest Solar Project" http://www.renewableenergyfocus.com/view/43763/construction-to-begin-on-east-africa-s-largest-solar-project/

[80] https://www.esi-africa.com/industry-sectors/renewable-energy/kenya-first-utility-scale-ipp-solar-project-achieves-financial-close/

[81] Kenya Wall Street (2019) "Kenya's 80MW Utility Scale Solar Plants Projects to Receive Funding" retrieved at https://kenyanwallstreet.com/kenyas-80mw-utility-scale-solar-plants-projects-to-receive-funding/

floating solar PV plant is under construction in the Seychelles. Located on the lagoon at Le Rocher, in the central Mahe district of Les Mamelle, the utility-scale floating solar PV system will be the first in Africa[82].

In terms of CSP, Africa installed capacity accounts for about one fifth of the total global installed capacity (975MW)[83]. The CSP market is dominated by Morocco and South Africa. Morocco is home to the largest CSP plant in the world. The Noor power plant located in the Drâa-Tafilalet region was constructed by a French led consortium. The Moroccan Agency for Solar Energy had received around $3bn fund from the African Development Bank (AfDB), the Climate Investment Funds (CIF), European financing institutions and the World Bank to develop the Noor-Ouarzazate complex. The project comprised three phases; Noor I has an installed capacity of 150MW and was connected to the power grid in 2016, Noor II and III comprise a 200MW CSP plant and 150MW CSP plant respectively and was synchronized to the grid in September 2018. Noor IV will be a solar PV plant with a generation capacity of 72MW and construction began in 2017[84]. In South Africa, the largest CSP plant, Kath is located in the North Cape region. The 100 MW plant was inaugurated on and will supply power to 179,000 households and save 6 million tonnes of CO2 over the next 20 years[85].

TuNur CSP project is Tunisia's most ambitious renewable energy project yet. The project consists of a 2,250 MW solar CSP plant in Sahara Desert and a 2 GW HVDC (High-Voltage Direct Current) submarine cable from Tunisia to Italy[86]. The project aims to bring two gigawatts of CSP to the UK from Tunisia[87]. In July 2017, TuNur solar project in Tunisia is a joint venture between Nur Energy, a British-based solar developer and a group of Maltese and Tunisian investors in the oil and gas sector. The company had filed a request for authorisation from the Tunisian Ministry of Energy, Mines and Renewable Energy for an explicitly export-oriented solar project with a capacity of 4.5 GW. The 250-MW first phase of the project will be implemented by 2020 for an estimated cost of 1.6 billion euros.

The distributed and decentralised PV market has also witnessed some notable developments although it remains the least developed market in comparison to the utility scale and off grid markets. The majority of grid connected solar PV systems have been installed in North African countries and South Africa[88]. South Africa and Tunisia have particularly developed markets and Morrocco has successfully deployed grid connected solar PV to electrify some villages in the country. Notable developments have included the government of Tunisia's PROSOL- Elec Programme initiated in 2010 to support grid connected solar PV in the residential sector. The programme entails an innovative financing mechanism that combined investment grants and loans. The grant covers 30% of the investment cost of the PV system[89]. In Morroco, the

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[82] https://www.pv-tech.org/news/seychelles-set-for-4mw-floating-solar-plant

[83] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

[84] Power Technology (2016) "Morocco Commissions First Phase of Noor -Ouarzazate Solar Power Project" retrievable https://www.power-technology.com/news/newsmorocco-commissions-first-phase-noor-ouarzazate-solar-power-project-4803152

[85] Recharge (2019) "South Africa Cuts Ribbon on Landmark Kathu 100MW CSP" retrievable at https://www.rechargenews.com/solar/south-africa-cuts-ribbon-on-landmark-kathu-100mw-csp/2-1-586586

[86] EcoMENA (2020) "Solar Energy Prospects in Tunisia" retrievable at https://www.ecomena.org/solar-tunisia/

[87] OpenDemocracy (2017) "Another Case of Energy Colonialism: Tunisia's Tunur Solar Project" retrievable https://www.opendemocracy.net/en/north-africa-west-asia/another-case-of-energy-colonialism-tunisia-s-tunur-solar-pro/

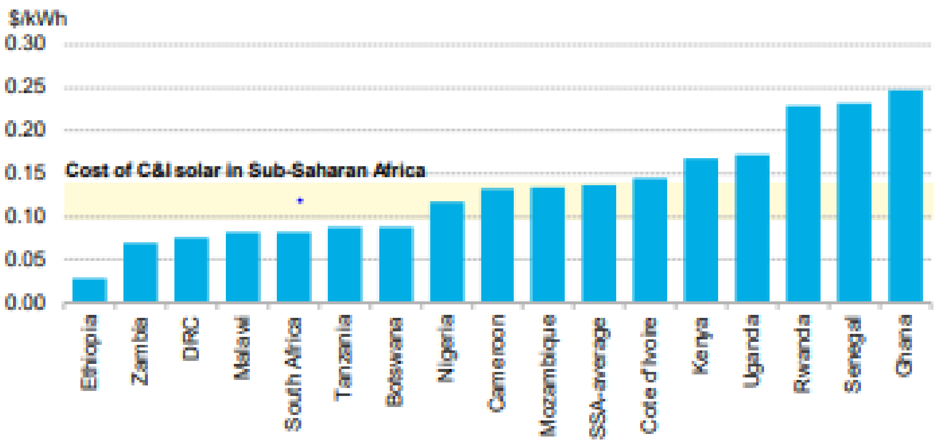
[88] IRENA (2016) "Solar PV in Africa: Costs and Markets" *International Renewable Energy Agency 2016*

[89] Ibid

government initiated the deployment of SHS as a way of promoting rural electrification in 1996 which initiative also included grid extension. The initiative has deployed more than 5,000 SHS and provided grid access to more than 19 million people[90]. In South Africa, small scale distributed solar represents approximately one fifth of the solar market between 2013 and 2015[91]. In 2015, an estimated 170MW of rooftop solar were installed[92]. Whilst grid connected roof top solar in other markets in Africa remains underdeveloped, progress is being made to encourage roof top solar. Several countries have introduced or are in the process of intruding net metering and embedded generation regulations/schemes. These regulations/schemes typically allow a customer to be both a consumer and prosumer by selling electricity generated on-site through the utility. In 2015, Mauritius rolled out its 5MW roof top solar installations through phase 1 of net metering scheme which included equipment tax incentives[93]. Namibia is also in the process of revising its net metering regulations and distributed generation market structure, but has had to overcome some implementation challenges in the past[94]. In Ghana, net metering was introduced through the Net Metering Sub-Code for Connecting Renewable Energy Generating Systems to the Distribution Network in Ghana[95]. The Energy Act 2019, whose regulations are being drafted, for the first time introduced net-metering in Kenya.

Solar for businesses in Africa is also economically viable and beginning to gain steady traction[96]. According to BloombergNEF (BNIF), which undertook a study to assess the potential and target markets for commercial and industrial (C&I) in Sub-Saharan Africa. The study reported that onsite solar is cheaper than the electricity tariffs paid by C&I clients in seven out of the 15 markets that were studied[97].

Figure 16. Economics of Solar vs Commercial Grid Electricity Tariffs



Source: BloombergNEF, 2019

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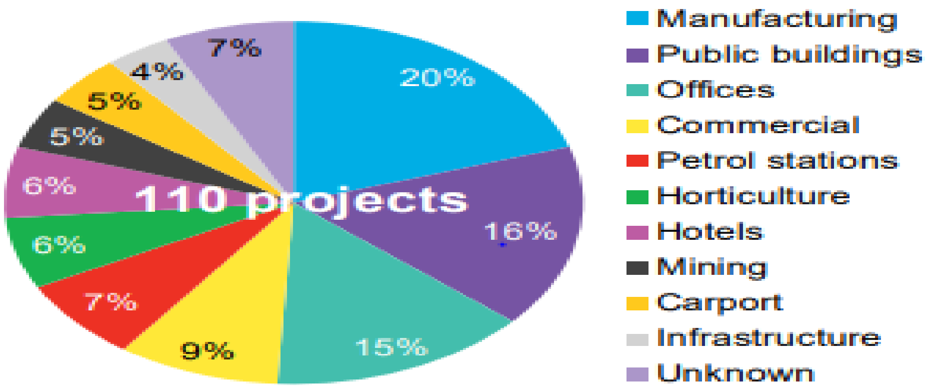
90 Ibid
91 Ibid
92 Ibid
93 ESIAfrica "Net Metering Rules & Distributed Generation Market Opportunity" retrievable https://www.esi-africa.com/top-stories/net-metering-rules-distributed-generation-market-opportunity/
94 Ibid
95 LEXAfrican "The Development of Solar Photovoltaic Market in Ghana" retrievable at https://www.lexafrica.com/2019/08/the-development-of-a-solar-photovoltaic-market-in-ghana/#:~:text=In%202015%2C%20net%20metering%20was,the%20Sub%2DCode%E2%80%9D).&text=The%20system%20owner%20is%20charged%20for%20all%20electricity%20purchased.
96 ResponsAbility and BloombergNEF (2019), "Solar for Businesses in Sub-Saharan Africa" *24 January 2019*
97 Ibid

The study reported that there were 74MWof installed C&I solar capacity recorded in sub-Saharan Africa (except South Africa)[98]. The study further reported that projects in the pipeline could result in the doubling of installed capacity in 2019. According to the report, the largest customers for on-sight solar, outside of South Africa, were manufacturing sector; out of the 110 projects studied, 20% were for manufacturing[99].

Figure 17. C&I Solar Customer Types



Source, BloombergNEF, 2019

The study found that the majority of the projects had been financed through private funds and that the financial sector had largely been absent from this market so far. The study further found that regulatory support in this market was minimal and that this market is growing largely because of economics[100].

Off grid solar applications have had a tremendous impact on rural electrification in Africa. Solar off-grid applications comprise mini grids (i.e. isolated grids that involve small scale electricity generation and which serve a limited number of consumers in isolation from the central grid and in relation to which back-up power can be batteries and/or diesel generators) and stand-alone systems (i.e. SHS or pico systems that are not connected to the central grid and supply power to individual appliances, houses and small businesses)[101]. Off grid applications are critical for reaching remote areas and the millions of Africans that live far from the central grid. Off grid solar has scaled rapidly over the past decade in Africa and Asia primarily driven by household lighting and basic appliances. In Africa, solar lighting products have dominated sales[102]. According to GOGLA, an estimated 4.1 million solar lighting products were sold globally in 2019 with at least half of those sold in sub-Saharan Africa[103]. But the sector is beginning to move beyond lighting to televisions, fans and radios. An estimated 730,000 off grid solar appliances were sold globally with 184,000 products sold in sub-Saharan Africa[104]. East Africa dominates the market for off-grid applications in Africa as demonstrated by the graph below:

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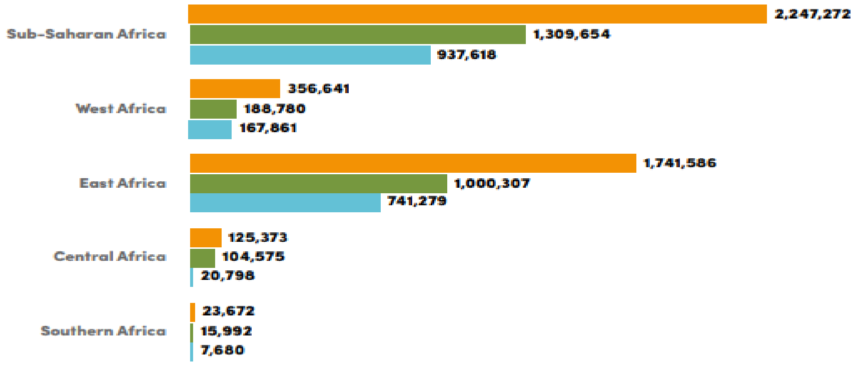
[98] Ibid
[99] Ibid
[100] Ibid
[101]Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*
[102] GOGLA, (2019). "Global Off-Grid Solar Market Report: Semi Annual Slates and Impact Data" *January – June 2019, Public Report*
[103] Ibid
[104] Ibid

Figure 18. Volume of Off-Grid Solar Products per African Region



Source: GOGLA, 2019

The Off Grid solar sector has largely focused on consumptive use of energy however, the industry is increasingly turning towards productive use leveraging solar energy (PULSE) products[105]. PULSE encompasses a wide range of products including solar water pumps and cold storage for agricultural applications and refrigeration and other small appliances for microenterprises [106]. Productive use of power enables or enhances income generation for rural households and microenterprises by amongst other things, mechanization of commercial activities that are otherwise performed manually[107]. In particular, these appliances have the ability to impact agriculture on which rural households in Africa rely. There is a growing application of solar irrigation at small holder farmer scale in Africa. Product innovation coupled with declining prices have made micro application for DC pumps more viable in Africa. Solar water pumps for irrigation are available in Kenya and Zimbabwe with both countries registering several distributors[108]. Solar refrigeration is also beginning to find a market for targeted applications, such as milk chilling and fish freezing, however these applications are more applicable to larger or more organized farmers. In countries such as Kenya where value chains are relatively well commercialised, there is strong aggregation of small holder farmers particularly in export/cash crops, there is greater potential for these applications[109].

4.3. Drivers for Solar Energy in Africa

The developments in solar energy in Africa have been driven by a number of factors. Firstly, there have been a global cost reduction for both solar PV and CSP. Solar PV prices in particular have declined significantly. According to the International Renewable Energy Agency (IRENA), the cost of crystalline solar PV modules declined by about 90% between December 2019 and December 2020[110]. The total installed costs in the residential rooftop PV market are higher than utility scale due to their small size but decreased by between 47% and 80% between

105

106 Lighting Global (2019) "The Market Opportunities for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" *(Washington, DC: The World Bank, May 2019) https://www.irena.org/publications/2019/May/Tracking-SDG7-The-Energy-Progress-Report-2019.*

107 Ibid

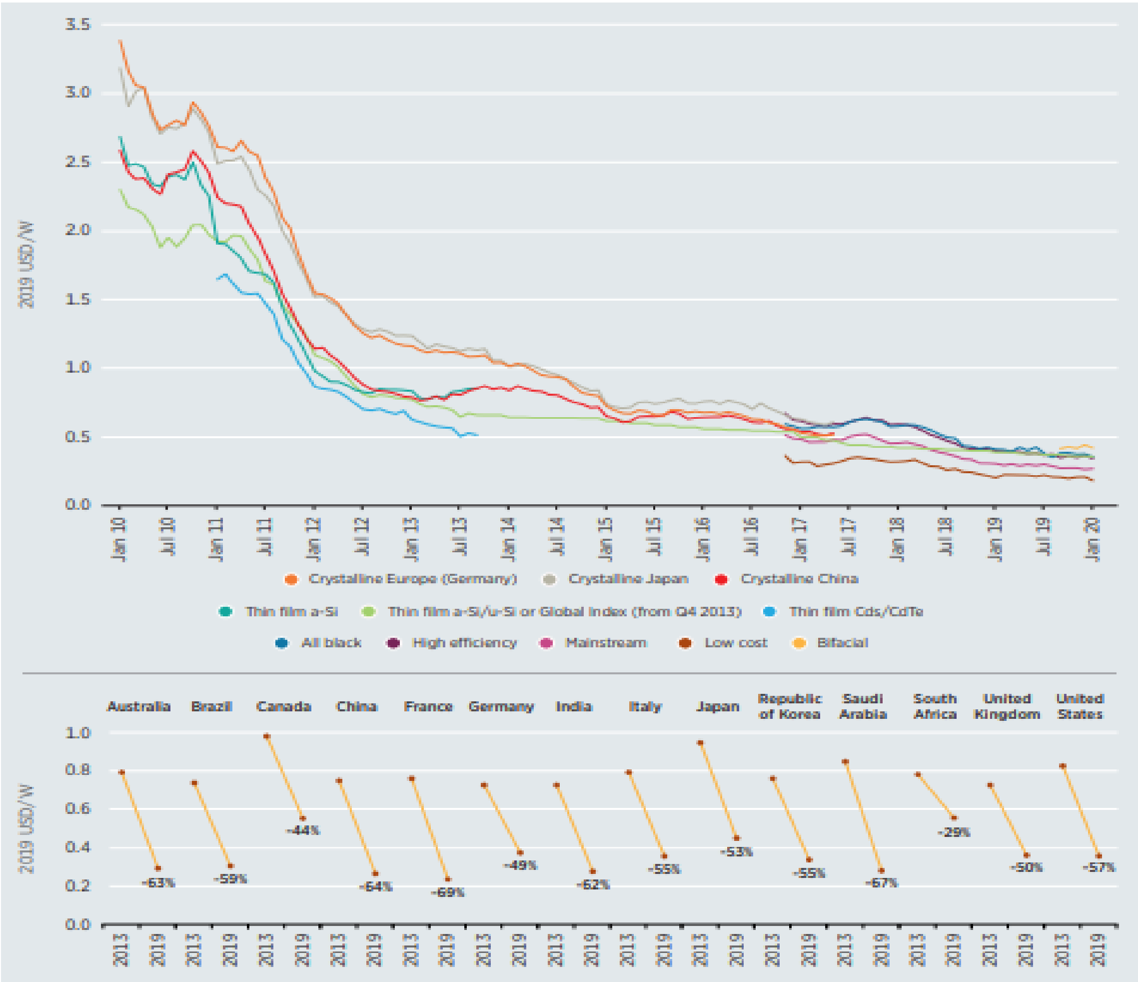
108 Ibid

109 Ibid

110 IRENA (2020) "Renewable Power Generation Costs in 2019*" International Renewable Energy Agency, Abu Dhabi*

2010 and 2019 depending on the market[111]. The reductions in the cost of PV modules has been caused by improved manufacturing processes, declining labour costs and enhanced module efficiency as a result of new technologies[112]. Further, as project developers gain more experience and markets continue to grow and become more sophisticated, declining balance of systems costs have followed. As a result, the global weighted-average levelized cost of electricity (LCOE) of utility scale PV plants declined by 82% between 2010 and 2019, from around USD 0.378/kWh to USD 0.068/kWh in 2019, with a 13% reduction year-on-year in 2019[113]. The below figure demonstrates comparative cost reductions of other PV module technologies as well as percentage price reduction in selected markets between 2013 and 2019.

Figure 19. Average monthly solar PV cost by technology and manufacturing country sold in Europe from 2010 to the First Quarter of 2020 and average yearly PV module prices by market in 2013 and 2019.



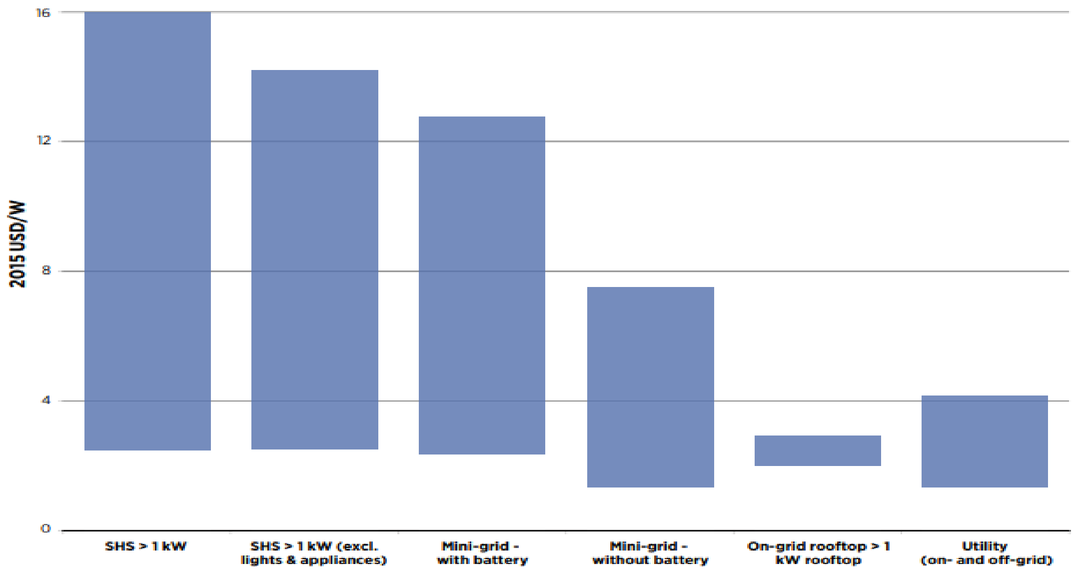
Source: IRENA, 2019

The cost of solar PV in Africa ranges depending on the market segment and size as evidenced by Figure 20 below. On one end of the spectrum, utility scale solar had estimated costs of between USD 1.35 and USD 4.1/W and at the other end SHS had costs of between USD 4.3

[111] Ibid
[112] Ibid
[113] Ibid

and USD 14.2 kW.[114] SHS are considerably more expensive due to the added expense of batteries and lack of economies of scale that utility scale solar systems are able to exploit[115]. Roof top systems in the larger than 1kW range have lower costs ranging between USD2 and USD 3/W. Mini grids without battery have a somewhat higher cost that utility scale systems are USD 2.5 to USD 2.9/W[116]. For mini-grids relying more heavily on solar PV, where a battery is included, the total system cost can be double or triple that of mini grids without batteries, with a range of between USD 2.5 and USD 10.9/W. This represents the fact that many of these systems are greenfield in nature and have higher project development costs, in addition to the costs associated with batteries. However, it is expected that prices will continue to reduce[117].

Figure 20. Solar PV price ranges in Africa by market segment and size, 2009 - 2016



Source: IRENA, 2016

Through the CSP market is promising, CPS has not experienced the same steep reduction in prices as PV and therefore remains less competitive in comparison to PV. The IRENA reported that the weighted average LCOE of CSP plants fell by 47% between 2010 and 2019, from USD 0.346/kWh to USD 0.182/kWh. Further, the global weighted-average total installed costs of CSP plants commissioned in 2019 were USD 5 774/kW which is one-tenth higher than in 2018, but 36% lower than in 2010[118].

Secondly, conducive policy environments have facilitated an increase in solar energy in Africa. Renewable energy targets exist in almost all African countries. Tax reductions/exemptions are a common instrument, and exist in some form in almost 30 countries in Africa[119]. Several countries also support renewables via direct public investments, loans or grants. Capital

[114] IRENA (2016), "Solar PV in Africa: Costs and Markets" *International Renewable Energy Agency 2016*
[115] Ibid
[116] Ibid
[117] Ibid
[118] IRENA (2016), "Solar PV in Africa: Costs and Markets" *International Renewable Energy Agency 2016*
[119] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

subsidies or rebates are employed in 13 countries[120]. In addition, countries have introduced innovative tariff policies on solar products. In 2008, the Kenyan government launched feed-in-tariff (FiT) policy to support grid connected renewable energy which was in 2010 extended to include solar PV[121]. Similarly, Rwanda introduced its own FiT in 2012 which is under revision to provide for a small power project agreement (SPPA) as well as a FiT for solar PV. As of 2017, FiTs and Feed in olicies (FiPs) had been adopted by ten African countries, amongst which Egypt and Uganda have their FiT scheme already completed. In 2017, Zambia launched its 200 MW FiT strategy for small and medium scale renewable energy systems up to 20 MW to improve rate of access in rural areas[122]. There has also been an increase in use of renewable energy auctions for larger projects in Africa as policymakers seek to procure renewable energy-based electricity at the lowest prices[123]. 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[124]. South Africa has been leading this development having introduced the Renewable Energy Independent Power Producer Procurement Programmein 2011. This was followed followed by Uganda's GET FiT solar facility auction in 2014 and Zambia's Scaling Solar auction in 2015[125].

The third factor has been donor support which can take many forms from DFIs providing concessional loans, to bilateral foreign aid agencies offering grants, direct subsidies, technical assistance, capacity building and project preparation and implementation support to NGOs and charities with diverse objectives such rural electrification[126]. Donor support is crucial in ensuring not only financial support for renewable energy projects but also technical and technological transfer. The three main multilateral donors in the energy sector in Africa are the World Bank, the European Union and the African Development Bank[127]. While the multilateral donors participate and manage various multi-country programs, the majority of multilateral lending is made available via loans and grants to individual national governments[128]. The Global Environment Facility (GEF) and the Green Climate Fund (GCF) are two other important sources of funding in the renewable energy sector in Africa[129]. There are a number of key bilateral donors that offer different forms of technical and financial assistance to African countries, including the Agence Française de Dévéloppement (AFD), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the German development bank, Kreditanstalt fuer Wiederaufbau (KfW), the Japanese International Cooperation Agency (JICA), the Japanese Bank for International Cooperation, the Swedish International Development Cooperation Agency, the Danish International Development Agency and the UK's Department[130] .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

[120] Ibid
[121] 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*
[122] Ibid at 115
[123] IRENA (2019) "Future of Solar Photovoltaic" *International Renewable Energy Agency, 2019*
[124] Ibid
[125] IRENA (2018), "Renewable energy auctions: Cases from sub-Saharan Africa" International Renewable Energy Agency, Abu Dhabi.
[126] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*
[127] Ibid
[128] Ibid
[129] Ibid
[130] Ibid

dealers as well as micro-finance institutions[131]. Government policy initiatives have been supplemented by donor programs supporting the development of the private SHS 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[132]. In addition, both bilateral and multilateral donor agencies have launched a significant number of new initiatives at the regional and sub-regional level to support the energy sector and renewable energy in Africa over the past years such as the Power Africa and World Bank Energy Sector Management Assistance Program ESMAP[133].

The fourth factor impacting solar uptake is the innovative financing models and technological advancements in this sector. The emergence of SHS pay-as-you-go (PAYG) in 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[134]. 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. One of the key drivers of this financing model is increased mobile phone penetration in sub-Saharan Africa. African mobile phone companies offer payment platforms linked to a mobile phone account, without the need to open a bank account. In terms of individual countries Kenya, Namibia and South Africa are the leaders[135]. However mobile money usage penetration is very high in countries such as Gabon, Ghana, Uganda, Zimbabwe, Rwanda and Tanzania and in other countries mobile money access is increasing. Crowdfunding has also been used in countries with higher investment risks. In Nigeria, the EU, GIZ and the USAID-funded Renewable Energy and Energy Efficiency Project (REEEP) in collaboration with the Nigeria's state government provided USD 150 million funding for six pilot solar mini grids providing 15,000 people access to reliable electricity[136]. The German crowdfunding platform Bettervest was used with the aim of penetrative the Nigerian market137. Finally, the Desertec concept has gained traction in North Africa. Desertec refers to the concept of Producing electricity with renewables in the desert[138]. In 2017, the Tunisian based company TuNur launched a request to export 4,5 GW of solar energy to Europe.

4.4. Barriers to Solar Energy Development in Africa

A number of key barriers would need to be surmounted before Africa's power sector can fully realise the potential contribution of solar energy. Key barriers at the utility scale include limited institutional capacity, administrative delays, non-bankable PPAs and difficulties in securing transmission grid connections[139]. In addition, contentious land rights are hampering project

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

[132] Ibid

[133] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

[134] GOGLA "Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data" *July-December 2009, Public Report*

[135] 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*

[136] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

[137] Ibid

[138] Ibid

[139] Ibid

development and increase uncertainty in the most African markets[140]. Other key berries relate to the technical capacity of grid infrastructure and off-taker credibility of local utilities[141]. 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[142]. African grids 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[143]. Another important barrier to centralized solar PV is the issue of 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 companies to honour payments to power suppliers[144]. 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[145]. Some FiT schemes in Africa tend suffer from unfavorable institutional design, insufficient levels of FiT rates or obstacles in the process of implementation[146] . This is often the result of conflicting policy targets like affordable power prices and grid stability but unclear allocation of property rights which often leads to time consuming negotiations over PPAs.

The biggest challenges with distributed and decentralised systems are low grid coverage and unreliable grids[147]. 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[148]. Because of the extended downtimes in electricity in African countries, Africa's grids are not always reliable forms of storage[149]. Although some countries have introduced FiTs reality shows that many countries are facing difficulties in its application. The key reason for this is the lack of political will to create a regulatory framework for its implementation[150].

In terms of off-grid systems, the key challenges in most African countries including is up-front cost, increase in low quality/counterfeit products and lack of qualified technicians to install and maintain solar systems[151]. Whilst significant progress has been made in introducing innovative

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[140] Ibid, See Wind Turkana Wind Farm land lawsuit as an example retrievable at https://www.business-humanrights.org/en/latest-news/kenya-lawsuit-by-locals-against-lake-turkana-wind-power-over-land-allocation-community-participation-slowing-down-project/
[141] Ibid
[142] Quansah D., Adaramola M., and Mensah, L.D "Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential" *2016*
[143] Ibid
[144] Ibid
[145] Ibid
146 Meyer-Renschhausen, M, (2013) " Evaluation of Feed-in Tariff-schemes in African countries". Vol 24 No 1 (2013): *Journal of Energy in Southern Africa*
[147] Quansah D., Adaramola M., and Mensah, L.D "Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential" 2016
[148] World Bank, "Fact Sheet: The World Bank and Energy in Africa" *The World Bank Group, 2013*
[149] Quansah D., Adaramola M., and Mensah, L.D "Solar Photovoltaics in Sub-Saharan Africa – Addressing Barriers, Unlocking Potential" 2016
[150] IEA (2918), "Net Metering and PV Self-Consumption in Emerging Countries' *Report IEA-PVPS T9-18:2018*
[151] Ibid at 146

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. In terms of PULSE, affordability is also a key constraint. Water pumps and cooling units can reportedly cost between US$ 600 – 2000[152]. Even where there is asset financing (which is often not available) the monthly repayments for PULSE products can reportedly reach US$20-75 cost prohibitive for most rural people.

A second challenge in 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[153]. Thirdly, the solar sectors of Africa lack local technicians with the requisite skill set to install and maintain solar infrastructure[154].The specific skills required for small-scale PV installations is electricity generation. Such work may be done by an electrician with additional solar PV training or by a specialized PV installer[155]. 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[156]. 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[157] However, it is clear that installations and maintenance are still being carried out but by unlicensed or inexperienced technicians in some cases.

5. Solar Power During the COVID 19 Pandemic – Powering Healthcare and Mitigating Impacts

Energy has been crucial in the fight against the COVID pandemic. Reliable energy supply is required to ensure that core systems for the management of health programs can function effectively. Furthermore, clean electricity can address some of the health risks that may make people more vulnerable to respiratory diseases such as COVID-19. Given the importance of

[152] Lighting Global (2019) "The Market Opportunities for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" *(Washington, DC: The World Bank, May 2019) https://www.irena.org/publications/2019/May/Tracking-SDG7-The-Energy-Progress-Report-2019.*

[153] GOGLA "Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data" *January-June 2018, Public Report*

[154] Ibid

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

[156] Ibid

[157] Ibid

electricity in responding to the pandemic and the fact that the majority of Africans are not connected to the grid and the grid is in any event unreliable, distributed stand-alone solutions have become critical. Solar energy provides a solution that can be deployed rapidly and governments and stakeholders are recognising this fact. Several countries have recently implemented initiatives for solar adoption to meet energy needs. Initiatives to assist companies mitigate the impact of COVID 19 has also been implemented.

Little Sun, a social enterprise that produces solar powered LED lamps and chargers to over to countries in Africa, is equipping community health workers with their solar-powered phone chargers so they can use their phones to care for patients in areas without electricity[158]. In April, Nigeria's Rural Electrification Agency unveiled solar-related pandemic response measures in partnership with the African Development Bank and World Bank. The initiative provides grants to households to install SHS, as well as install medical and health centers with mini-grid solar solutions[159]. In Kenya, 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[160].

In Nigeria, off-grid energy impact investing company All On, seeded by Shell, announced a N180 million assistance program to assist renewable energy companies, Auxano, Arnergy, GVE and Lumos to provide solar power for emergency health centers to aid in the fight against pandemic. The COVID-19 Solar Relief (CSR) Fund will be made available immediately to the selected off-grid energy companies to provide solar power to emergency health facilities around Nigeria, through various private and social sector initiatives. The investees will tap into initiatives that support the national effort to alleviate the burden on the nation's fragile health care sector in this time of crisis[161].

First Aid Africa, a Scottish charity with operations in Africa supporting sustainable healthcare, and Renovagen Ltd, a UK supplier and manufacturer of innovative portable renewable energy equipment, recently announced the success of a rapid response project to support testing operations in the fight against pandemic in Zambia. One of Renovagen's Fast Fold portable solar power systems was deployed by the project to Mbereshi Mission Hospital following an urgent request made by the hospital. The hospital was struggling with delivery of tests because electricity was only available for only 6 hours a day and it was extremely erractic. Due to logistical and procurement challenges, fuel for generators was unavailable at the hospital. This impacted the number of tests which could be completed and caused valuable reagents to be wasted as tests were being interrupted by electricity outages. With reagents being in such short supply, this was a critical issue that needed to be addressed162.As an immediate response to the pandemic, SolarAid, an international charity that combats poverty and climate change is

[158] Little Sun (2020) "Little Sun's COVID – 19 Response : Powering Health" retrievable at https://littlesun.com/covid-19-response/

[159] Smart Energy International (2020) "COVID -19 to Accelerate Solar Adoption Across Sub-Saharan Africa" retrieved from https://www.smart-energy.com/renewable-energy/covid-19-to-accelerate-solar-adoption-across-sub-saharan-africa/

[160] Kenya News Agency (2020) "JKUAT Unveils Innovations to Fight Covid- 19" 2020 Retrieved from https://www.kenyanews.go.ke/jkuat-unveils-innovations-to-fight-covid-19/

[161] All On (2020) "All On Announces N180 Million COVID 19 Solar Relief Fund to Power Emergency Health Care in Nigeria" retrievable at https://www.all-on.com/media/media-releases/all-on-announces-n180-million-covid-19-solar-relief-fund.html

[162] Africa Business Communities (2020) "Portable Solar Power System Boosts COVID – 19 Testing in Zambia" retrievable at https://africabusinesscommunities.com/news/portable-solar-power-system-boosts-covid-19-testing-in-zambia/

supplying over 4,000 free solar lighting and power products to help equip health workers and provide light and power for rural healthcare facilities, quarantine areas and referral hospitals in Zambia and Malawi[163].

In response to the COVID-19 challenge and committed to the promotion of inclusive sustainable development, the United Nations Institute for Training and Research (UNITAR) and Solarkiosk launched a multi-sectoral, multi-partner collaboration to support preparedness and response in Africa, at the national level. They Launched a Solar Power Initiative to aid in the fight against the pandemic[164].

Meanwhile, 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[165]. 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.

6. Solar Power Beyond COVID 19 – Accelerating Inclusive and Sustainable Economic Development

Solar power is playing an important role in the fight against the pandemic and can play an even bigger role in accelerating inclusive and sustainable development post COVID 19. Businesses in Africa must innovate to survive the impact of COVID-19 which impact is likely to be felt for the foreseeable future. Solar mini grids can assist businesses to save money and hedge against energy costs[166]. How much money businesses can save with solar mini grids will depend on the energy source they currently use, which for the majority of businesses, is principally electricity purchased from the central grid[167]. As of 2017, in countries such as Ghana, Senegal, Rwanda and Kenya, the electricity tariffs for commercial customers cost more than a 250kW solar project and were often lower or on par for industrial customers[168]. In addition to saving costs, on-site solar allows customers to lock in fixed or predictable costs for years in contrast to the costs of electricity from the city grid which is adjusted from time to time[169] According to BNEF projections based on expected manufacturing and installation expenses, it is suggested that the cost of on-site solar will decline to about $0.05/kWh by 2030 from the current $0.10-0.14/kWh. Solar mini grids can also improve power supply for businesses in countries with very erratic power supply so they can save on diesel costs or avoid losing sales or manufacturing output[170].

Recovering from the pandemic with renewable energy investment will create more jobs than investment in fossil fuels. According to the IRENA, investments in renewable energy create

[163]Solar Aid (2020) "Covid – 19 is not Over" retrievable https://solar-aid.org/covid-19-is-not-over/

[164] Solarkiosk "Solarkiosk & UNITAR launch a "Solar Power Initiative Against COVID 19" retrievable https://www.solarkiosk.eu/solarkiosk-unitar-launch-a-solar-power-initiative-against-covid-19-increasing-response-capacities-of-african-healthcare-systems/

[165] Redavia Solar Power (2020) "REDAVIA Delivers Free Solar During COVID – 19 Crisis" retrieved from https://www.redaviasolar.com/redavia-delivers-free-solar-during-covid-19-crisis/

[166] ResponsAbility and BloombergNEF (2019), "Solar for Businesses in Sub-Saharan Africa" *24 January 2019*

[167] Ibid

[168] Ibid

[169] Ibid

[170] Ibid

three and half times the number of jobs as similar sized investment in fossil fuels171. Increased solar installations can lead to job creation across the value chain from production to sales. According to SE4All, every 1,000 customers connected to decentralized energy solutions supports approximately 25 jobs[172]. According to a report by the New Climate Institute on the role of renewable energy in Kenya's electricity sector, for every 1 MW of mini-grid capacity developed, approximately 800 full-time-equivalent job-years are created in Kenya[173]. In order to maximise the potential for job creation, it will be necessary to promote domestic industry. In this context, local content regulations will be relevant. In this regard, developing a well-articulated and coherent local context policy (LCR) is important[174]. LCR is a crucial element in promoting local manufacturing, developing local supply chains and driving innovative industries[175]. South Africa is a prime example in which LCR has successfully been used to develop the local market. The Preferential Procurement Policy Framework Act (PPPFA) regulations which came into force in 7 December 2011 and empower the Department of Trade and Industry to designate industries, sectors and sub-sectors for local production at a specified level of local content. Within the framework of the Renewable Energy Independent Power Producer Procurement Program, the Department of Trade and Industry (DTI) developed and implemented a table of socio-economic output to be met or exceeded in order to become a "preferred bidder" in a tender[176]. Under the program, each renewable energy project requires, amongst others, a minimum of 40% participation by a South African entity and that at least 30% of the plant's capital cost (local equipment manufacturing, operation and maintenance and research and development) must come from the local industry[177]. In Morroco, local market development has been pursued by introducing regulations favoring the local industry indirectly combined with local industry financing. The Moroccan Agency for Solar Energy is responsible for managing a solar auction scheme to install 2,000 MW across five sites in Morocco by 2020. The Agency operates a two-phase auction process: a pre-qualification phase and an evaluation phase. In the evaluation phase, the selection is based purely on price. The Agency also sets a condition on local requirement: 30% of the plant's capital cost (local equipment manufacturing, operation and maintenance and research and development) must come from the local industry. Further, the Agency is responsible for promoting research and development, technical education and training to support this local content requirement as a means to improving economic conditions and creating jobs in country[178]. Kenya is also making progress in this area. The government has set targets intended to promote local manufacturing as part of the Vision 2030. This is evidenced by the Energy (Local Content) Regulation of 2014 which is intended to promote energy generation through locally available resources. The Regulation appreciates the importance of promoting local assembly. Apart from Solinc Company which assembles solar panels in Kenya, almost all solar products in the market are imported[179].

171 IRENA (2016). "Solar PV in Africa: Costs and Markets" *September 2016*

172 SE4All, (2020) "The Recover Better with Sustainable Energy Guide for African Countries" *30 June 2020*

173 Thomas, D, Kurdziel, M and Barasa, M (2019) "The Role of Renewable Energy Mini-grids in Kenya's Electricity Sector: Evidence of a cost-competitive option for rural electrification and sustainable development" *New Climate Institute under the Ambition to Action project, November 2019*

174 Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

175 Ibid

176 Ibid

177 Ibid

178 Ibid

179 UNDP (2017) "Accelerating Pico-Solar Photovoltaic Lighting Market in Kenya" *Policy Brief November 2017*

In developing individual country policies, the following key questions regarding local manufacturing would need to be considered:

(i) what are the current challenges of local manufacturing?

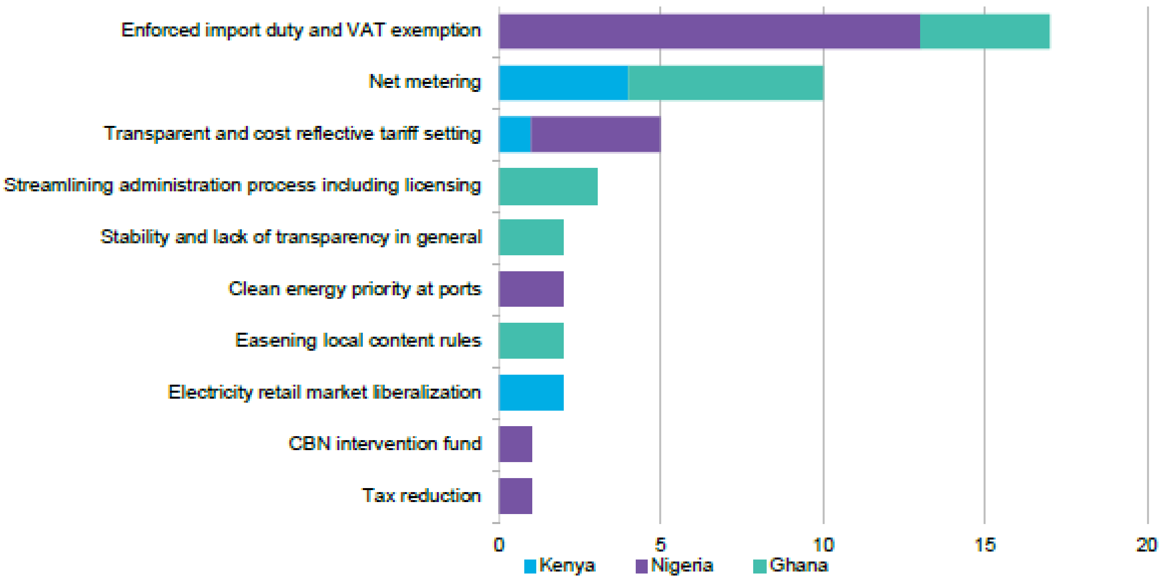
(ii) what are the support structures necessary for local manufacturing to support design, testing of equipment, product certification and reference laboratories? and

(iii) what policy and regulatory framework is required?[180]

African governments should also consider policies that protect the local manufacturing industry from unfair competition from imported goods particularly influx of counterfeit products. Local manufacturing also brings down costs. Therefore, governments should target direct and indirect investments to operationalize assembly plants and achieve economies of scale that can bring down the cost of solar systems considerably[181]. Direct investment can include loan guarantees or contributing capital for the upfront investment in assembly plants. Indirect investments that should be considered include reducing or eliminating import duties and value-added taxes (VAT)[182]. It is clear that incentives are wide in nature but those that have huge impact in localization of renewable energy technologies can include grants for R&D from diversified financial resources, tax deductions for investments in research and development[183].

To encourage uptake of solar applications amongst the business community (commercial and industrial) and spur job creation, conducive policy environments, development in human capital, increased consumer awareness and availability of data will be required. C&I solar developers expressed that regulatory change should concentrate on better enforcement of existing duty and tax exemptions on solar modules. Import taxes and fees can reportedly add approximately 50 percent to the retail cost of solar systems, even where these systems are assembled locally, due to costs from high customs, VAT, and local taxes[184].

Figure 21. Regulatory Reforms that C&I Solar Business Players Want



Source: BloombergNEF, 2019

[180] Ibid

[181] Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

[182] Ibid

[183] Ibid

[184] Tralac, (2020) Road to Nigeria's Economic Recovery, *2020*

Although the C&I solar market in sub-Saharan Africa (excluding South Africa) has largely developed without much regulatory support, driven by competitive economics and unreliable grids, net metering and FiTs could assist businesses and (private households) to generate revenue/make further cost savings. Generation of additional income or further cost savings will build resilience amongst businesses. African governments should consider introducing net-metering programs and tariff structures to allow consumers to benefit from the excess energy that they produce. In this context, smart grids will play a central role chiefly through facilitating smooth integration of renewable energy sources such as solar, dynamically balance and optimize generation, delivery and loads[185]. Other technical benefits include improved reliability and resilience and providing flexibility and visibility of the entire grid[186]. Smart meters are particularly crucial; smart meters enable a two-way flow of information on the amount of energy consumed by an end-user, the time of consumption, the price of electricity at that time[187]. Smart meters also enable the collection, storage and reporting of consumer data for any specific time period[188].

African governments should mobilise public financing to trigger investment inenabling infrastructure for renewable power in particular investments in smart grids. This can partly be achieved by redirecting public finance away towards energy transition-related investment and away from fossil fuels. This should be coupled with elimination of fossil fuel subsidies. With the price of oil the lowest it has been for 18 years, this presents the unique opportunity to float liquid fuel prices, which in any event will result in a short-term benefit for consumers. When the cost of fossil fuels rises again, African governments should refrain from re-introducing the subsidy. Whilst the cost of investing in smart grids would be large, smart grids have certain long-term cost- savings benefits when compared to conventional grids including transmission loss reduction, peak demand reduction and overall energy efficiency[189].

Secondly, if governments seeking to promote job creation should make concurrent investments in human capital in order to ensure that the technological and industry know-how is available to meet the need as local industries are established. Technical, business and entrepreneurship training are all necessary to develop local industry and meet the needs of what could be a sizeable domestic market[190]. Equally important is the need for African governments to invest in the human capital within their institutions tasked with developing and implementing energy programmes. This would include, amongst others, regulators, state-owned utilities, and implementing agencies and relevant ministries.

Creating awareness programmes and making key information of solar products and the solar industry can help investments in the sector. Customer awareness of solar as an option to reduce energy costs is still very low[191]. Developers report that customers in Sub-Saharan Africa express skepticism about the reliability and economics of using new technologies such as solar.

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185 Frost & Sullivan (2018). "Digitization of Energy Transmission & Distribution in Africa - The Future of Smart Energy in Sub-Saharan Countries" *2018*

186 Ibid

187 Ibid

188 Ibid

189 Smart and Just Grids: Opportunities for sub-Saharan Africa

190 Becquerel Institute and BSW-Solar e.V. (2019) "Solarize Market Report: Africa" *German Solar Association*

191 ResponsAbility and BloombergNEF (2019), "Solar for Businesses in Sub-Saharan Africa" *24 January 2019*

Solar is often associated with small off-grid solutions that provide intermittent power in a rural setting as potential mistakenly believe they would be disconnected from the main grid if they installed solar. As a result, factory owners are often hesitant to install solar. Solar vendors have to spend a lot of time convincing procurement managers that the technology works and can function in conjunction with the grid and back-up power sources to provide reliable power[192].

Off grid solar will be vital for post-COVID 19 recovery in Africa and in promoting long term inclusive and sustainable development. Off grid solar vital in providing basic lighting and clean cooking technologies which women and girls particularly benefit from. It is reported that wages for women with access to energy are 59 percent higher than those without, which increases the chances of achieving equal pay and gender equality[193]. Similarly, switching to clean cooking solutions can free up time which can be used for more economically productive activities and foster female entrepreneurship[194]. In Kenya evidence showed that female entrepreneurs in the clean-cooking value chain outsold men by almost 3:1[195]. However, as earlier discussed there must be efforts to move away from basic lighting and clean cooking technologies to productive uses of solar energy to ensure economic benefit. In putting together their stimulus packages, African governments should prioritise specific sectors such as health and agriculture. According to research undertaken by the WHO, following the equipping of 36 primary health clinics in Uganda with solar powered vaccine refrigerators, the number of functioning refrigeration units capable of cooling life-saving vaccines tripled, from 32% to 96%[196]. Similarly, research showed that access to just one piece of electrical processing equipment is capable of increasing agricultural yields for smallholder farmers by 30%[197].15 In addition, refrigeration and cold chain as can contribute to food loss elimination.

A number of measures can be put in place to ensure that investments both in basic solar equipment and productive use solar equipment are driven as fast as possible. The measures include significantly reducing red tape, reducing the number of permits required and the time it takes to procure required permits for solar energy and solar cooking equipment and appliances. Provision of data is also very important; such data should include information on communities that are optimally positioned for commercial investments in electrification and rate of adoption and data on impact of solar clean cooking solutions. Such data should be made public for all market actors to utilize. Reliable and comprehensive data is crucial in developing sustainable policies[198]. Governments should also strive to maintain a predictable business environment by avoiding frequent changes in policy and regulation which may contribute to delay or negatively affect the economic viability of decentralised solutions.

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192 Ibid

193 SE4All, (2020) "The Recover Better with Sustainable Energy Guide for African Countries" *30 June 2020*

194 Ibid

195 ESMAP, Clean Cooking Fund Business Plan FY 2021–2024, 14 MAY 2020

196 UN Foundation, Implementation research carried out by WHO on behalf of the UN Foundation to explore the impact of a DFID-supported grant for the sustainable electrification of 36 health facilities in Ghana and Uganda focusing on maternal and newborn health services, 2019

197 Efficiency for Access Coalition (2020) " Agriculture & Energy Efficiency – Increasing Agricultural Productivity Enhanced Food and Income Insecurity" Retrievable at https://efficiencyforaccess.org/themes/agriculture-energy-efficiency

198 IEA (2020) "Africa and Covid - 19: Economic Recovery and Electricity Access Go Hand in Hand" retrievable https://www.iea.org/commentaries/africa-and-covid-19-economic-recovery-and-electricity-access-go-hand-in-hand

In order to stimulate the PULSE sector, market development, innovative partnerships, and better coordination between energy and agriculture actors will be required. Governments can assist by incorporating PULSE products into their electrification and agricultural transformation strategies and policies, with the support of development actors199. Despite their importance to rural agricultural productivity, PULSE products are often not included in national strategies[200]. In addition, PULSE appliances can be promoted by integrating them into broader public schemes, such as irrigation schemes, subsidy programs and agricultural value chain development initiatives[201]. Further support could be provided through provision of credit guarantee facilities, results based financing, and other relevant initiatives. By highlighting their importance in policy and other initiatives, governments can signal to industry that there is a market opportunity thereby promoting new market entrants. By way of illustration, the Government of Kenya with the support of the World Bank and through its KOSAP program launched a results-based financing facility to incentivize Off Grid Solar players to expand into more remote, rural regions.

In the African context, stand alone and decentralised systems are likely to play a central role in the short run in accelerating inclusive development given that they are mobile, scalable and affordable to fit the unique needs of a community and of individual customers. However, utility scale solar is and will be required to drive long-term sustainable development. African countries should pursue large-scale investments in renewables especially utility scale solar projects. In Africa, each USD 1 million invested in large-scale solar generation projects creates around 80 jobs[202]. However, limited institutional capacity, administrative delays, non-bankable PPAs, utility fiscal stress, limited financing, old and outdated grids that contribute to trouble securing transmission grid connections, land rights all contribute in hampering further progress and increase the uncertainty in the market. As discussed previously, governments must make significant investments in the strengthening and modernizing transmission infrastructure in order to allow for the integration of a significant shares of large-scale centralized power plants. The new transmission infrastructure would need to have a portfolio of dispatchable power technologies (both conventional and nonconventional) that have the ability to ramp up and down at the required rates in order to cater for fluctuations that Solar PV plants introduce to the interconnected systems. This would improve reserve margin of the power systems.

Government support in implementing projects is also crucial in attracting investment. One of the keyways in which African governments signal and can signal political will is through renewable energy targets and national commitments. As discussed earlier, most African countries have these in place. However, the targets and commitments need to be backed by action. As previously discussed, bankability has been problematic in Africa. Governments should consider providing guarantees which improve the credit quality of projects. In addition, bankability can be achieved through local ownership which not only alleviates developmental risks but allows for the involvement of the local community on the project with associated economic and social benefits[203]. In order to ensure investor confidence and avoid project delays, governments should strengthen and clarify land rights. Land rights are central to

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199 Lighting Global (2019) "The Market Opportunities for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" *(Washington, DC: The World Bank, May 2019) https://www.irena.org/publications/2019/May/Tracking-SDG7-The-Energy-Progress-Report-2019.*

200 Ibid

201 Ibid

202 IRENA (2016)" Solar PV in Africa: Costs and Markets" *September 2016.*

203 PVTech "Five Steps to Successful Utility – Scale in Africa" retrievable at https://www.pv-tech.org/editors-blog/five-steps-to-successful-utility-scale-solar-in-africa

renewable energy projects and their importance cannot be over-stated as the bankability of any power project is contingent upon, among other considerations, the availability of adequate land for the project. Governments should also consider developing standardized PPAs in order to accelerate negotiations and project lead times. Again, availability of data is crucial. Such data can include information on optimal renewable sites and land tenure rules. Governments should also invest in training and capacity building to increase the technical capacity of both relevant government departments and the national utility. Whatever policies/actions are taken by governments, these must be accompanied by broader reforms to increase sustainable investments in the sector. These reforms should include transparent procurement processes, cost-reflective tariffs in so far as FiTs are concerned, accountability for official corruption, fiscal transparency and long-term energy sector planning.

As Africa looks to long term sustainability, regional integration becomes relevant. Regional integration is essential to ensure that energy resources move from localities where they are most affordable, to where they are most required. Correspondingly, regional integration pursuant to the African Continental Free Trade Agreement (AfCFTA) is expected to improve security of supply[204]. Generally, developing countries tend to have domestically centred view of electrification. For instance, only about 5% of energy is traded across borders in Africa[205]. However, regional market integration and trade in energy, especially in developing countries like those in Africa, offers significant benefits central of which is mitigating the risk of supply shocks. Regional integration increases energy capacity at a regional scale enabling individual countries to meet growing national electricity demands by integrating operational reserves and installed capacity which may eliminate the need for individual countries to invest in additional power facilities. Should countries still wish to invest in additional power facilities, they can benefit from the free movement of good and import materials from those counties that have developed local industries.

While efforts to trade energy and integrate grids are locally supported through existing regional power pools (e.g. Eastern Africa Power Pool and the Southern African Power Pool) the AfCFTA provides a new platform to expand these efforts regionally and pursue energy development to relieve the energy infrastructure restraint. Improved and increased energy trade and energy integration is expected to boost economic development in Africa by reducing transaction costs and enabling market and economic collaboration and ultimately accelerating investment incentives. AfCFTA is excepted to accurate investment in Africa by, amongst other things, guaranteeing potential investors access to information. Signatories to the Agreement are required to publish their laws, regulations, procedures and administrative rulings of general application as well as any other commitments under an international agreement relating to any trade matter covered by the agreement. It is expected that the publishing of such information will make the inter-state market conditions more transparent and therefore appeal to potential investors.

7. Conclusion

The COVID 19 pandemic continues to wreak havoc around the world and its effects are likely to linger for the foreseeable future. Worst still, the worst effects of the pandemic will be felt in

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[204] Yussuf A, (2019) "Challenges and Prospects of Addressing Energy Access and Climate Change in Africa through the Proposed Continental Free Trade Area (CFTA)" January 2019

[205] Africa Progress Panel - Africa Progress Report (2015) "Power, People, Planet: Seizing Africa's Energy and Climate Opportunities" https://reliefweb.int/sites/reliefweb.int/files/resources/APP_REPORT_2015_FINAL_low1.pdf

countries with vulnerable populations, a majority of which are in Africa. As nations consider economic packages to jumpstart their economies post COVID 19, energy access ought to be a central consideration and renewable energy can play a key role in building back better and stronger. Solar energy is already playing a central role in the fight against the pandemic by providing reliable power to health centres at the forefront of the fight against the pandemic and off-grid solar was playing a crucial role in promoting inclusive development in Africa.

Plummeting oil prices as a result of containment measures in response to the COVID 19 pandemic threaten to derail progress made so far on clean energy. Falling costs and strong policy support made renewables increasingly attractive and competitive in many economies including those of Africa. However, renewable energy including solar energy now face a number of challenges as a result of the coronavirus crisis key of which are supply chain disruptions resulting in delays in project completions and the likely decrease in investment as a result of pressure on public and private finances combined with uncertainty over future electricity demand. More than ever, governments will be key in addressing these challenges by determining the pace of deployment of renewables post COVID 19. However, solar energy is expected to bounce back quicker than other sources of renewable energies.

Both economic stimulus packages aimed at propping up economies and long-term policies will be critically important in driving the transition to clean energy in Africa. When designing these packages and long-term policies, African governments should consider the structural benefits that renewable energy can bring in terms of economic and social development and job creation while also reducing harmful emissions and fostering technology innovation. The disruption of supply chains of renewable energy technologies as a result of COVID 19 is one of the key lessons for the African continent to focus on the localization of manufacturing of renewable energy technologies. In order to promote off grid solar, decentralized solar applications and utility scale solar, African governments with the aid of internationals actors need to design policies aimed at, amongst others things, stimulating local industry, encouraging research and development to promote innovation, increasing awareness, promoting productive use solar appliances, developing information databases, building human capital, building institutional capacity, reducing red-tape, simplifying land rights and attracting private local and international finance.

The coming into force of AfCFTA presents a unique opportunity for cross border trade in energy. Under the AfCFTA, the common market and resulting free movement of labor, goods, services, and capital should promote economic diversification, structural transformation, technological development and quality job creation. This should make energy cheaper in future and promote economic development in Africa.

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