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Financing Energy Access in Sub-Saharan Africa

by Nicola Bilotta and Lorenzo Colantoni

ABSTRACT

The electrification of Sub-Saharan Africa has traditionally suffered from a lack of adequate investments, given the scarcity of domestic funds and the higher regional risk perceived by foreign investors. And yet, electrification of the continent has accelerated lately, driven by innovative financing instruments that fit the African framework. Such tools as aggregation, securitization and guarantee instruments reduce risk premiums, thus increasing the attractiveness of the sector and making it easier for international institutions to provide back-up funding for private, local and decentralized projects. Critical in this regard has been Africa's FinTech system, which enables forms of mobile payment and micro-credit access, resulting in innovative business models. Such sets of tools will be then fundamental to maintaining the current trends and, eventually, reach the long-awaited universal access to energy for those in Sub-Saharan Africa.

Sub-Saharan Africa | FDI | Energy | Electricity | Sustainable development

keywords

Financing Energy Access in Sub-Saharan Africa

by Nicola Bilotta and Lorenzo Colantoni*

1. The future of Africa's power

1.1 Introduction

The energy sector of Sub-Saharan Africa (SSA) is currently undergoing a series of transformations that could eventually lead to the universal energy access the region has been struggling to achieve for decades. After years of decreasing access to power, in 2014 the trend was reversed, and the growth rate of the number of people reached by electricity surpassed the population growth rate for the first time in decades.[1] This has been the result of a combination of factors – the spread of renewables and off-grid solutions, the economic growth (as well as the ambitious electrification plans) of some African countries, such as Ethiopia and Kenya – and these can have major economic and social consequences for SSA.

Yet, according to forecasts by the International Energy Agency (IEA), such a positive trend may not last. If adequate measures are not taken at the national, regional and international level, the access-to-power rate in SSA could stall and, by 2021, begin once again to decrease. The current 598 million people without electricity in the region could become 665 million by 2030 (sse Figure 1). A series of supporting measures are then required, involving the development of an effective regulatory framework, coherent energy policies, energy systems able to fully exploit the current changes in the availability of energy supply brought in by the fall in costs of renewables, and the recent gas discoveries in Mozambique, Ghana and Angola. Most crucial in maintaining momentum in the electrification of SSA is affordable energy finance, specifically tailored for African needs, both from a quantitative and a qualitative perspective.

[1] IEA, *Energy Access Outlook 2017*, October 2017, p. 80, https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf.

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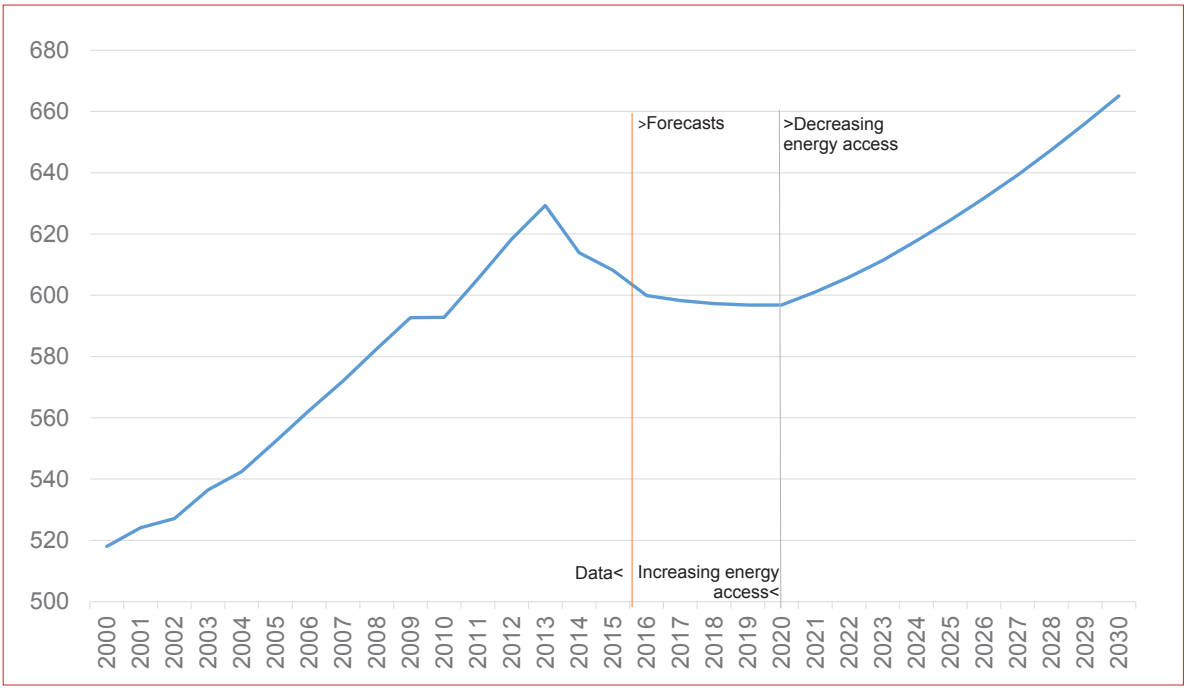
Figure 1 | Population without energy access in Africa



Source: IEA data for Colantoni et al. (2018).

1.2 An estimate of Africa's energy financial needs

The financial flows required to reach universal access by 2030 are substantial. Estimates, however, have oscillated significantly in the past five years. The 2015 McKinsey report "Brighter Africa" set the financial needs for universal energy access at 835 billion US dollars by 2040 (reaching the target by 2030 was not considered to be realistic).[2] However, also in 2015, the International Renewable Energy Agency (IRENA) estimated that the necessary funding to reach full energy access was in the range of 424 to 793 billion US dollars for the period 2015–30 (28 to 53 billion US dollars a year).[3] In 2017 the IEA again lowered the threshold, to around 370 billion US dollars (28 billion US dollars a year) between 2017 and 2030;[4] furthermore as little as 84 billion US dollars (6 billion US dollars a year) would be needed if only 60 per cent of the SSA population were to gain access.[5] Despite differences in the models' calculations, these variations reflect the magnitude of changes in the SSA energy sector in only a few years, particularly for countries such as Kenya and Ethiopia, which tripled and doubled their access-to-power rate between 2012 and

[2] Antonio Castellano et al., *Brighter Africa. The Growth Potential of the Sub-Saharan Electricity Sector*, McKinsey, February 2015, p. 17, http://bit.ly/2lV1wHT.

[3] Asami Miketa and Nawfal Saadi, *Africa Power Sector: Planning and Prospects for Renewable Energy*, Abu Dhabi, IRENA, March 2015, p. 14, https://www.irena.org/publications/2015/Mar/Africa-Power-Sector-Planning-and-Prospects-for-Renewable-Energy-synthesis-report.

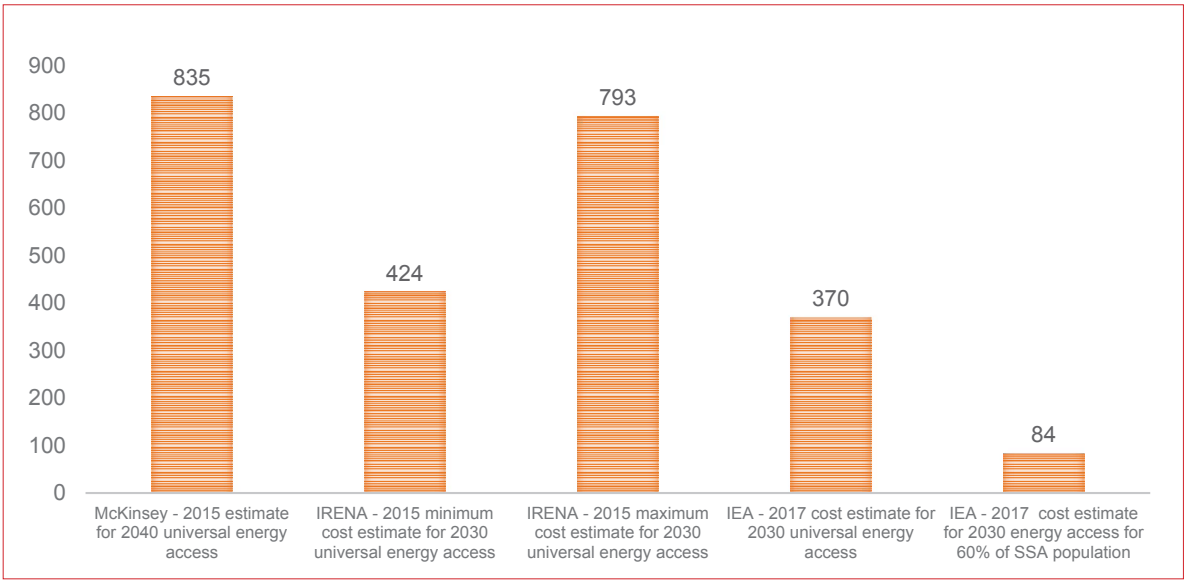
[4] IEA, *Energy Access Outlook 2017*, cit., p. 91.

[5] Ibid., p. 90.

ISSN 2610-9603 | ISBN 978-88-9368-089-9

2016, respectively.

Figure 2 | Estimates of financial needs for SSA energy access (US dollars)



Source: Elaborated by the authors from various sources.

These advancements have been influenced by growing African hydro and fossil fuels capacity, as well as by the development of energy solutions more suitable to the African context, and which will lead to an electrification process likely very different to that which took place in Europe or China. In SSA, on-grid generation will still represent a large part of the new required capacity, but probably no longer the dominant part or even the majority. According to the IEA, if only 60 per cent of the African population is to get access to energy by 2030, 73 per cent of the new energy required will be supplied by the national grid. Yet, in a universal energy access scenario, on-grid capacity will only cover 46 per cent, while the rest will be divided between mini-grids (30 per cent) and other off-grid solutions (24 per cent), such as solar home systems.[6]

Off-grid generation has a series of advantages for a large part of the African population, particularly the rural one, as it solves the issue of the dispersion of the population, requires smaller investments and is now affordable even for many of the most fragile consumers. The IEA's expectations for great progress are at least partially shared by institutions such as the World Bank, which has started focusing its renewed efforts on energy access programmes on mini-grid and off-grid projects. As such business is growing, medium-sized and major energy companies, such as EDF and Engie, are already showing interest.[7]

[6] Ibid., p. 88-89.

[7] Joe Bavier, "Off-Grid Power Pioneers Pour into West Africa", in *Reuters*, 20 February 2018, https://reut.rs/2BEGZO3.

IAI PAPERS 18 | 22 - DECEMBER 2018
ISSN 2610-9603 | ISBN 978-88-9368-089-9

1.3 The financial troubles of the Sub-Saharan energy sector

Such major investment needs raise a number of financial issues that need to be addressed to guarantee the development of the African energy sector. Generally speaking, the SSA energy sector has suffered from the same chronic difficulty as African infrastructural projects in finding adequate investments, due to the lack of domestic funds as well as to a higher perceived regional risk – a sort of "African risk premium". While estimates vary by sector, energy technology, country and timeframe, such risk is the result of a series of factors of instability (political troubles, GDP fluctuations, corruption and lack of transparency, currency risk), commonly perceived as much worse than they actually are, particularly by those which have yet to invest in SSA – thus producing one of the greatest gaps in the world between perceived and real risk.[8] This is particularly damaging to large-size investments, such as those needed for gas-to-power plants, utility-scale solar and wind plants and the development of the distribution network.

Lack of access to capital is partially a consequence of insufficient domestic investments and foreign direct investment (FDI), but it is also caused by an often unstructured or unstable banking system – as proved by frequent banking crises, such as the one that has recently hit Ghana.[9] While impacting large-size projects as well, the recurrence of banking crises particularly hinders the advancement of small- to medium-scale solutions (particularly off-grid), which could also be developed by local entrepreneurs were they to have an accessible line of credit.

Utility-scale renewables and gas-to-power plants are affected by the limited development of the SSA energy sector as a whole. Intermittent renewables work best in a structured energy regulatory framework, as the lack of coordination can lead to higher costs or a decreased output due to, for instance, curtailment, that is, to the impossibility of using renewable energy not because of a lack of sun or wind, but for regulatory and market management issues – and which led to a 10 to 15 per cent loss of output in Chinese wind energy in 2016, for instance.[10] Gas-to-power is influenced by the lack of a solid distribution network in most African countries – not only regarding electricity, but also for gas transmission itself. Nigeria's gas sector, for instance, is largely underdeveloped because of the country's inability to develop a proper distribution system over the last two decades,[11] and thus it

[8] Zahné Coetzee et al., "Profiling Sectoral Risks of Foreign Direct Investment (FDI) in Africa for the First Decade of the 21st Century", in *Journal of Economic and Financial Sciences*, Vol. 9, No. 1 (April 2016), p. 158, https://hdl.handle.net/10520/EJC189977.

[9] Stacey Knott, "Ghana Backpedalling Out of Banking Crisis", in *Mail & Guardian*, 19 August 2018, http://bit.ly/2zVcYYw.

[10] Qi Ye, Jiaqi Lu and Mengye Zhu, "Wind Curtailment in China and Lessons from the United States", in *Brookings China's Energy in Transition Series*, March 2018, http://brook.gs/2Fj9enX.

[11] Philippe Copinschi and Mark Smedley, "Sub-Saharan Africa: A Future Global Gas Player?", in Silvia Colombo, Mohamed El Harrak and Nicolò Sartori (eds), *The Future of Natural Gas. Markets and Geopolitics*, Hof van Twente, Lenthe/European Energy Review, 2016, p. 191-193, https://www.iai.it/en/node/6340.

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continued to flare 12 per cent of its gas production in 2017 (up 2 per cent from the previous year[12]).

Globally speaking, on-grid generation is influenced by the state of the domestic energy sector as a whole. Unclear or easily changing regulations impede the entry of newcomers, and thus of private investors. In this sense, the rapidly evolving Kenyan power sector has favoured an involvement of the private sector, which has been driving the country's recent electrification. Compared to Ethiopia, whose significant results have been achieved mostly thanks to public investment in large-scale hydro power, Kenya's approach could insulate the expansion of access to power from GDP fluctuations and, partially, from political risks.[13]

The key obstacle to financing the electrification of SSA are its (prospective) energy consumers. The primary cause of the high risk in energy investments in the region is indeed caused by the low expected return – which is in turn a consequence of extremely low, or non-existent, or highly variable levels of consumption. It will be thus fundamental to deliver energy in a way that African consumers will be able to afford – even the poorest strata of the population, and rural consumers in particular.

2. Financial tools to power Africa

The financial challenge to preserve the great African energy transformation will require a combination of tools for:

- Making African national energy sectors more transparent, stable and ultimately more attractive to private investors.
- Reducing the risk premiums paid by investors, increasing access to finance and leveraging public (domestic and international) funding to boost private investments.
- Expanding the use of FinTech solutions, particularly mobile money, to empower African energy consumers, particularly by reducing upfront costs and facilitating payments.

2.1 Promoting a more appealing SSA energy sector

The appeal of the SSA energy sector will grow in a business-friendly environment. It will be fundamental for African countries to guarantee property rights, and promote a transparent and solid business environment with stable regulations

[12] Ndu Ughamadu, "Nigeria's Gas Flare Rate Now 12 Per Cent", in *NNPC News & Update*, 25 October 2017, http://nnpcgroup.com/PublicRelations/NNPCinthenews/tabid/92/articleType/ArticleView/articleId/869/Nigerias-Gas-Flare-Rate-now-12-Per-cent.aspx.

[13] Norton Rose Fullbright and Walker Kontos Advocates, *Investing in the African Electricity Sector: Kenya. Ten Things to Know*, July 2013, https://www.res4africa.org/wp-content/uploads/2016/10/investing-in-power-in-kenya-100614-003.pdf.

ISSN 2610-9603 | ISBN 978-88-9368-089-9

and a fair investment climate (avoiding governments "picking winners").[14] Ghana's economy outperformed the global economy in 2017, and will do so probably in 2018 as well, mostly thanks to a well-structured business environment, which compensated for the financial instability the country suffered in the 2010s.[15]

The energy sector will require specific action. Independent regulators will be fundamental to building investors' trust by boosting transparency, policy predictability, aligning targets with implementation measures, reducing the number of opportunities for corruption and improving governance. Several SSA countries are already developing such entities. In 2017, Mozambique finally managed to turn the energy advisory board it set up in 1997 into an independent authority, alongside other efforts to boost access to power also through gas-to-power capacity by building, for instance, a 400 megawatt plant and a 560 kilometre northbound transmission line.[16] Several other countries are also developing or have already established energy authorities, amongst them Ghana, Tanzania and South Africa.[17] Nonetheless, the influence of these regulators on national utilities is often weak, as happens in Nigeria and Zimbabwe. According to the 2018 Electricity Regulatory Index of the African Development Bank (AfDB), many African regulators still lack the capacity to fulfil their tasks.[18] The most delicate issue here is the definition of tariffs: out of the 15 SSA countries the AfDB considered, 67 per cent have non-cost-reflective tariffs for households, and 73 per cent for industrial and commercial consumers.[19] This is mostly due to a highly politicised process of defining tariffs, which hinders the development of the national energy sector by reducing the profitability of utilities. It is particularly damaging to private investors which, unlike public companies, have limited or no possibility of relying on government subsidies. The issue of tariffs is also detrimental to off-grid solutions, which have generation costs higher than on-grid plants. Mini-grids, in particular, would especially benefit from being exempt from national tariffs and having, for instance, a dedicated regulatory procedure to agree on energy prices that are closer to actual generation costs.[20] Considering the relatively short time needed to deliver and install mini-grids (often a few months), reducing times for custom controls and legal and licensing provisions is also of fundamental importance.

[14] Tilman Altenburg and Christian von Drachenfels, *Creating an Enabling Environment for Private Sector Development in Sub-Saharan Africa*, Vienna, United Nations Industrial Development Organization (UNIDO) and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), 2008, p. 8, https://www.die-gdi.de/uploads/media/Altenburg-Drachenfels_2008_BEE4PSDinSSA.pdf.

[15] PricewaterhouseCoopers (PwC) Ghana, *Doing Business and Investing in Ghana*, 2018, https://pwc.to/2IGKTqE.

[16] "Mozambique Gets New Energy Regulator", in *Medium*, 29 January 2018, https://link.medium.com/mvzY708ZAS.

[17] AfDB, *Electricity Regulatory Index for Africa 2018*, May 2018, https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Electricity_Regulatory_Index_2018.pdf.

[18] Ibid.

[19] Ibid., p. 14.

[20] Salvatore Vinci et al., *Policies and Regulations for Private Sector Renewable Energy Mini-Grids*, Abu Dhabi, IRENA, September 2016, https://www.irena.org/publications/2016/Sep/Policies-and-regulations-for-private-sector-renewable-energy-mini-grids.

ISSN 2610-9603 | ISBN 978-88-9368-089-9

Furthermore, the regulator has to protect mini-grids from competition with on-grid electricity; despite off-grid solutions being already developed in some areas served by the national grid for reasons of reliability and overall quality of the service, several mini-grid developers refrain from fully investing in Tanzania or Kenya because of a lack of a reliable, long-term planning of on-grid and off-grid capacity.[21] Indeed, they fear that the arrival of the grid, which usually supplies cheaper (or more subsidised) electricity, will reduce their margin or push them out of the market.

Specific action should be taken to develop on-grid renewables and gas-to-power, considering their potential for the electrification of SSA. As suggested by IRENA, overall work on renewable readiness is fundamental to promoting solar photovoltaic (PV) and wind energy, the development of which is still lagging behind in the region in all but a few countries (for example South Africa and Kenya).[22] A package of laws, grid codes, policies for independent power producers, integrated resource planning and subsidies is thus required. The effectiveness of the development of renewable sources will depend strictly on how coherent and complete this set of rules will be. In this, the use of tenders to assign contracts and build on-grid renewable capacity has proved particularly effective in SSA in recent years.[23]

The development of gas-to-power capacity will require a broad approach as well, focusing not only on delivering legislation, but also on extending gas consumption. The potential to increase gas demand in SSA is estimated at 400 gigawatts potential capacity.[24] This not only includes industrial consumption, but also households. According to the IEA, liquified petroleum gas (LPG) could be the key tool for providing clean cooking to the 800 million people that still lack it in SSA (particularly in urban areas).[25] Gas can also be employed for mini-grids, which are relatively cheap to install and are already in use in, for instance, Tanzania and Kenya, but their development is hampered by the cost of maintenance and spare parts (of significant relevance to rural areas). Small-scale liquified natural gas (LNG), for coastal areas, and compressed natural gas (CNG) projects for off-grid generation and local transport could also boost and thus increase the use of natural gas in SSA countries.[26]

[21] Ibid.

[22] IRENA, *Africa 2030: Roadmap for a Renewable Energy Future*, Abu Dhabi, IRENA, October 2015, https://www.irena.org/publications/2015/Oct/Africa-2030-Roadmap-for-a-Renewable-Energy-Future.

[23] Anton Eberhard and Raine Naude, *Recommendations for the Design of Successful Renewable Energy Auctions or Competitive Tenders in Africa . Lessons from South Africa*, UCT Graduate School of Business (GSB), April 2017, http://www.gsb.uct.ac.za/files/REIPPPPLessonsRecommendations%2Epdf.

[24] Antonio Castellano et al., *Brighter Africa*, cit., p. 3.

[25] IEA, *Energy Access Outlook 2017*, cit., p. 97.

[26] USAID and Power Africa, *Power Africa Gas Roadmap to 2030*, June 2018, p. 18, https://www.usaid.gov/documents/1860/power-africa-gas-roadmap-2030.

ISSN 2610-9603 | ISBN 978-88-9368-089-9

2.2 Private and public sector tools

There is a need to expand and deepen the policy approach towards SSA's energy industry, enabling private, public and international actors to cooperate in order to improve energy accessibility and affordability. So far, domestic and international efforts have mostly focused on funding projects to reduce Africa's infrastructure deficit, but have failed to develop appropriate financing instruments to improve the attractiveness of the energy sector. In order to scale up the deployment of energy technologies, the application of financing instruments is a key to reducing barriers and perceived risks for private and public investors.

Guarantee instruments unlock investments as they mitigate risks for investors. Instruments such as political risk insurance, export credit guarantees or partial risk guarantees, if issued by international bodies, reduce the uncertainty regarding political, policy and regulatory risks, improving privatecapital flows. Similarly, there are currency mitigation instruments that facilitate transactions in which revenues and loan payments are paid in different currencies – the former in local currency and the latter in hard currency. SSA economies suffer indeed from highly volatile domestic currencies, scaring off foreign investors with unpredictable fluctuations.

In addition to financing instruments which can help the energy industry as well as the whole economy of SSA countries, there are innovative financing instruments that suit SSA. One is financial aggregation, which bundles together risk mitigation and lower transaction costs and enables companies to refinance their portfolio at a lower capital cost due to a risk reduction.[27] In SSA, financial aggregation instruments, defined as mechanisms that aggregate capitals around a specific investment, can empower not only the supply of finance for decentralised energy – bringing together investors and diversifying risks across different investments – but also the demand side, pooling together final consumers who can assure investors of the sufficient scale of their investments.[28]

A wide range of aggregation approaches has been implemented to mitigate the different challenges of the renewable-energy market in SSA, with the common final aim being to offer cheaper finance to decentralized energy systems. Between these business models, financial aggregation has been particularly efficient in, for instance, small-scale projects with high upfront capital needs and in capital-intensive business models, like PayGo solar systems.[29]

[27] Clare Shakya and Rebecca Byrnes, "Turning Up the Volume. Financial Aggregation for Off-Grid Energy", in *IIED Issue Papers*, October 2017, p. 4, http://pubs.iied.org/16636IIED.

[28] Abhishek Malhotra et al., "Scaling Up Finance for Off-Grid Renewable Energy: The Role of Aggregation and Spatial Diversification in Derisking Investments in Mini-Grids for Rural Electrification in India", in *Energy Policy*, Vol. 108 (September 2017), p. 657-672.

[29] Francis M. O'Sullivan and Charles H. Warren, "Solar Securitization: An Innovation in Renewable Energy Finance", in *MIT Energy Initiative Working Papers*, July 2016, http://energy.mit.edu/?p=14940.

ISSN 2610-9603 | ISBN 978-88-9368-089-9

Jointly with financial aggregation, securitization could be a driver for the future of energy in SSA. In 2015, BBOXX, a British distributed energy services company operating in Kenya, issued asset-backed notes secured by 2,500 instalment sales contracts that accounted for the unpaid share of the solar system the company had previously installed.[30] An investment firm then purchased the asset-backed notes, hoping to gain future profits from the operation.[31] The advantage of a securitization transaction is that it enables holders to re-finance their own debt, attracting investors with marketable assets. As a result, securitization boosts the instalment of decentralized energy systems, increasing electrification in SSA. Lendable, a Kenyan financial platform, aggregates outstanding solar consumers' loans and leases, selling then the secured assets to international investors.[32] To attract investments, Lendable has developed risk assessment algorithms that gather and process data from installers and final consumers, validating the future consumer consumptions and payments.

The aim of guarantee instruments, aggregation and securitization mechanisms is to boost Africa's electrification through local projects and private investments. This shift of development paradigm is encouraging public and international organizations to back local projects and private investments rather than financing and managing large infrastructure investments. Power Africa – a programme launched by the Obama administration in 2013 – aims at increasing access to reliable and affordable energy in Africa through coordination amongst donors, development finance institutions and local communities. The programme does not function as a simple aid programme, as it tries to provide incentives and support private investments. So far, Power Africa has leveraged 50 billion US dollars in commitments from private and public actors, providing more than 10 million electrical connections.[33] Similarly, the External Investment Plan by the European Commission seeks to engage local financing for green investments with the backing of the Sustainable Use of Natural Resource and Energy Finance projects.[34]

[30] David ten Kroode, "First Securitization Deal for Off-Grid Solar in Africa", in *OikoCredit News*, 5 January 2016, https://www.oikocredit.coop/k/news/view/138533; BBOXX, *BBOXX Secures $15 Million Investment to Bring Solar Power to More Households in Africa*, 15 January 2016, http://www.bboxx.co.uk/?p=1864.

[31] Chris Aidun and Dirk Muench, *Securitization: Unnecessary Complexity or Key to Financing the DESCO Sector*, Persistent Energy Capital, November 2016, https://www.gogla.org/node/1176.

[32] See Lendable website: *About Us*, http://lendablemarketplace.com/about.html.

[33] Andrew Herscowitz, "Rethinking the Cost of Off-Grid Power: Let's Do the Math", in *Medium*, 5 October 2017, https://link.medium.com/OIFxLYH8AS.

[34] Silvia Napolitano, *Public-private Partnerships for the European External Investment Plan in Africa: Insights from the Experience of the French Cooperation in the West African Energy Sector*, Centro Studi di Politica Internazionale (CeSPI) and Centro Studi sul Federalismo, June 2018, http://www.cespi.it/en/node/639.

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2.3 Consumers' empowerment and the role of FinTech

The success of the aforementioned instruments is highly dependent on the empowerment of African consumers. So far, at the micro-level, two key structural challenges have mostly undermined energy-access improvements: (i) lack of payment solutions beyond cash-based systems; and (ii) high up-front costs of energy technologies.[35] In fact, the financial industry has traditionally been small in Africa, particularly in rural areas. SSA economies are still largely cash-based, whereby they also bear the high costs of cash payments such as manual transactions, security, transportation and storage. Around 80 per cent of those living in Africa lack access to formal banking services and bank penetration is below 35 per cent. Additionally, 389 million people live on less than 1.90 US dollars per day, having then no financial means to afford the up-front costs of off-grid solutions and of last-mile connections.[36] In SSA, the costs of a grid connection can vary from 400 to presumably 1,200 US dollars.[37] In Kenya, for example, a grid connection is estimated to be 400 US dollars, which represents a third of the average income per capita in the country.[38] Another example, again in Kenya, is the Mobisol solar kit, which costs around 700 US dollars per year over the first three years (later, power becomes free as consumers are also owners of the system).[39]

The mobile telephone revolution which is transforming Africa may unlock striking opportunities in the energy industry as well. There are around 444 million single mobile subscribers in SSA,[40] two-thirds of the adult population.[41] Mobile phones are relatively cheap and easy to use – not requiring a high level of literacy or numeracy;[42] they can also become financial means at lower costs than traditional banking.

The mobile money transition is the result of the interaction of two key trends: the rate of smartphone adoption, which in Africa is twice as high as the global rate; and

[35] James Morrissey, "The Energy Challenge in Sub-Saharan Africa: A Guide for Advocates and Policy Makers. Part 2: Addressing Energy Poverty", in *Oxfam Research Backgrounders*, January 2017, https://www.oxfamamerica.org/explore/research-publications/the-energy-challenge-in-sub-saharan-africa.

[36] Alex J. Alexander, Lin Shi and Bensam Solomon, "How FinTech is Reaching the Poor in Africa and Asia: A Start-Up Perspective", in *EMCompass Notes*, No. 34 (March 2017), p. 4, http://hdl.handle.net/10986/30360.

[37] Andrew Herscowitz, "Rethinking the Cost of Off-Grid Power: Let's Do the Math", cit.

[38] Rebekah Shirley, "Millions of Urban Africans Still Don't Have Electricity: Here's What Can Be Done", in *The Conversation*, 19 April 2018, https://theconversation.com/millions-of-urban-africans-still-dont-have-electricity-heres-what-can-be-done-92211.

[39] Andrew Herscowitz, "Rethinking the Cost of Off-Grid Power: Let's Do the Math", cit.

[40] Kenechi Okeleke and Xavier Pedros, "The Mobile Economy. Sub-Saharan Africa 2018", in *GSMA Mobile Economy Series*, July 2018, p. 2, https://www.gsmaintelligence.com/research/2018/07/the-mobile-economy-sub-saharan-africa-2018/683.

[41] Jake Kendall, Robert Schiff and Emmanuel Smadja, "Sub-Saharan Africa: A Major Potential Revenue Opportunity for Digital Payments", in *McKinsey Articles*, February 2014, http://bit.ly/2xT2aYR.

[42] Pew Research Center, *Cell Phones in Africa: Communication Lifeline*, 15 April 2015, http://pewrsr.ch/1PN5qIA.

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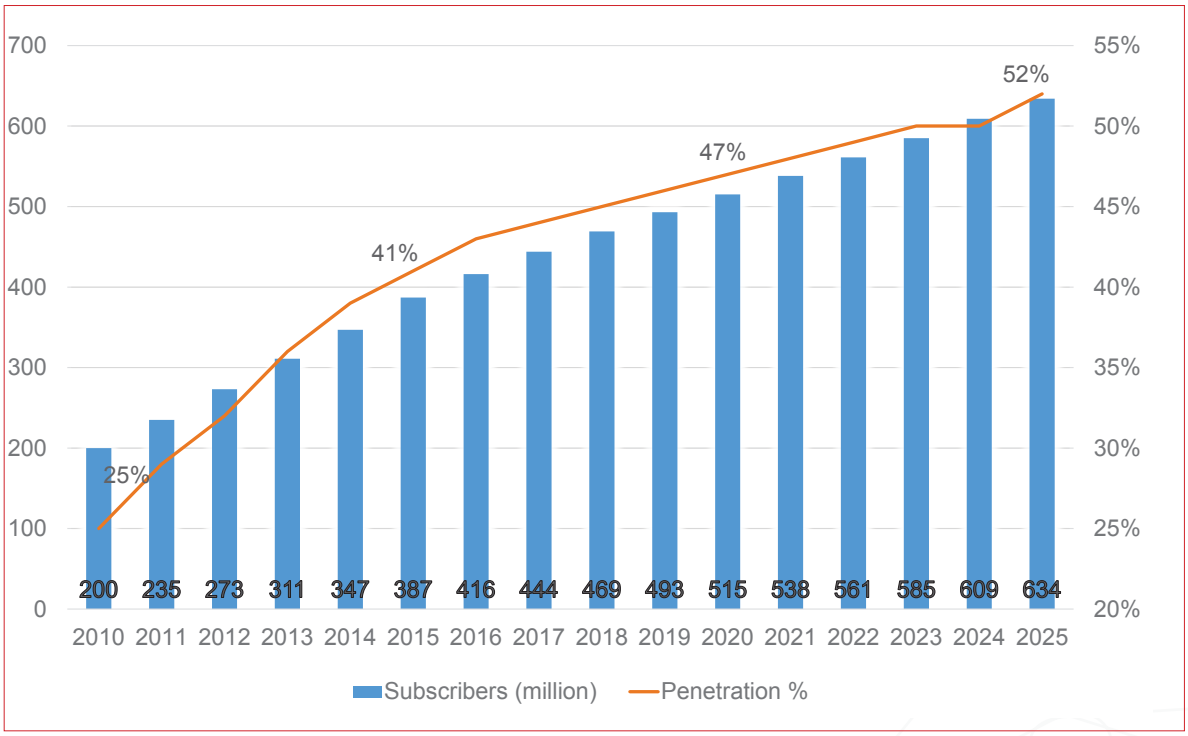
mobile internet usage, which is predicted to radically increase over the coming years,[43] reaching half a billion users by 2020.[44] SSA is driving the increased number of worldwide mobile money customers, accounting for 49.1 per cent of total mobile money accounts in the world, with around 338.4 million.[45] For instance, in Ghana the number of accounts grew from 2 million in 2012 to 10 million in 2017 out of a total population of around 23 million people.[46]

Figure 3 | SSA unique mobile subscribers (million)



Source: Elaborated by the authors from GSMA data: *The Mobile Economy. Sub-Saharan Africa* 2014 and 2018, https://www.gsmaintelligence.com/research/tags/mobile-economy-series.

The availability of mobile telecommunication infrastructures differs from country to country, affecting the macro-level and individual-level usage of mobile money.[47] However, in a region in which financial exclusion has historically been a key factor of economic and social underdevelopment, financial technology offers alternative solutions to solve old issues, partially solving drawbacks of cash payments in the

[43] Economist Intelligence Unit (EIU), *Mobile Money in Africa: Promise and Perils*, March 2016, http://www.mazars.com/Home/Sectors/Banking/Digital-Finance-campaign/Mobile-Money-in-Africa.

[44] GMSA, *The Mobile Economy 2017*, February 2017, p. 10, https://www.gsmaintelligence.com/research/2017/02/the-mobile-economy-2017/612.

[45] GSMA, *2017 State of the Industry Report on Mobile Money*, April 2018, p. 10, https://www.gsma.com/mobilefordevelopment/sotir.

[46] Ibid., p. 20.

[47] Ashenafi Beyene Fanta et al., "The Role of Mobile Money in Financial Inclusion in the SADC Region", in *FinMark Trust Policy Research Papers*, No. 03/2016 (December 2016), p. 3, https://finmark.org.za/mobile-money-and-financial-inclusion-in-sadc.

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energy sector.[48] Digital payments provide customers with safer, cheaper and more convenient alternatives to cash payments, reducing risks and transaction costs.

Mobile payments have thus empowered inclusive energy business models which target poorer social classes, unlocking the development of more affordable and more sustainable energy systems for excluded households.[49] Through mobile payment mechanisms and mobile micro-credit solutions, which are flexible and incremental, poorer households can more easily access decentralized renewable energy systems and on-grid solutions.

FinTech solutions may also help to reduce moral hazard and transaction costs for stand-alone systems – such as mini-grids, solar home systems and pico-solar systems. The costs of purchasing off-grid systems have been a barrier to their diffusion. Despite fast-reducing costs for stand-alone systems, such as a 50 per cent decrease in solar panel price over the last five years,[50] conventional consumer finance has not been sufficiently adequate to support poorer households. The synergy between energy and mobile has enabled innovative business models that have made off-grid solutions more affordable.

There are two main business models that make use of this synergy: (i) the *lease to own* model, which offers customers access to micro-credit directly provided by energy firms to purchase an off-grid system by letting them finalize the purchase through incremental monthly payments; and (ii) the *energy as service* model, which provides households with a loan for use of off-grid systems on which customers pay a one-off installation fee and a recurring fee for the energy usage.

For instance, Shenzhen JCN New Energy Technology, a Chinese firm, offers poorer households the opportunity to purchase a solar kit by making a small deposit – 10 per cent of the kit total value, which is around 80 US dollars – and monthly payments for the remaining fees. When customers reimburse their monthly fees, they receive a passcode on their mobile phone that activates the solar system. If customers do not pay their monthly fees, the solar system simply stops working. In Zimbabwe, Fenix International, an American enterprise, has offered "lease-to-own" solar systems partnering with MTN Mobile Money, an African telecommunication company, outsourcing cash payment to a mobile payment provider.[51] M-Kopa, a

[48] Simplice A. Asongu, "The Impact of Mobile Phone Penetration on African Inequality", in *MPRA Papers*, No. 46041 (31 August 2012), https://mpra.ub.uni-muenchen.de/46041.

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[51] Nixon Kanali, "Solar Firm Fenix International Reaches 150,000 Zambians in 9 Months", in *Africa Business Communities*, 6 September 2018, https://africabusinesscommunities.com/tech/tech-news/solar-firm-fenix-international-reaches-150,000-zambians-in-9-months.

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Kenyan solar energy company, works in five African countries and is offering a solar kit for an initial deposit of 35 US dollars and a subsequent daily payment of 0.43 US dollars per year through the M-Kopa mobile money application.[52] It is now installing 500 units per day,[53] targeting rural customers who live on less than 2 US dollars per day.[54] In Kenya, Uganda and Tanzania, M-Kopa has powered 400,000 households.[55] Mobisol, a pay-to-go solar energy service company, has installed more than 85,000 kits in East Africa, enabling 450,000 people to access electricity. Pay-to-go mechanisms are predicted to distribute renewable energy to 15 million households and 75 million people by 2020.[56] In 2016, for instance, 30 per cent of Kenya's households without prior access to the grid gained access to electricity through off-grid solar kits.[57] Lighting Global alone – a World Bank platform that supports the development of off-grid solutions – has provided access to electricity to more than 130 million people.[58]

Mobile payments may also play a role in reducing the initial charge for new last-mile connection, offering a flexible monthly fee through digital payments to pay back the full amount. This would also reduce information asymmetry – proof of identification, land rights – between providers and clients, decrease sunk costs and make legitimate connections more affordable as mobile payments allow frictionless transactions and digital channels for verification.

Mass-market adoption of mobile payments is progressively transforming financial access across multiple industry sectors. In Uganda, the number of consumers paying for electricity bills using mobile money grew from 2.9 per cent of total consumers in 2012 to 52.5 per cent in 2017,[59] thus attesting to the potential of the synergy between mobile money and energy access. By 2025, 52 per cent of SSA's population – 634 million people – will have mobile access,[60] which will empower energy business models founded on mobile money.

[52] Toby Shapshak, "How Kenya's M-Kopa Brings prepaid Solar Power to Rural Africa", in *Forbes*, 28 January 2016, https://www.forbes.com/sites/tobyshapshak/2016/01/28/how-kenyas-m-kopa-brings-prepaid-solar-power-to-rural-africa.

[53] M-Kopa Solar, *Company Overview 2018*, February 2018, p. 9, http://www.m-kopa.com/wp-content/uploads/2018/02/M-KOPA-and-Mobile-Money-Growth.pdf.

[54] Stephan Faris, "The Solar Company Making a Profit on Poor Africans", in *Bloomberg*, 2 December 2015, https://www.bloomberg.com/features/2015-mkopa-solar-in-africa.

[55] Erica Gies, "Africa Goes Off the Grid to Bring Power to Rural Villages", in *TakePart*, 8 December 2016, http://www.takepart.com/article/2016/12/08/africa-goes-grid-bring-power-rural-villages.

[56] Itamar Orlandi et al., "Distributed Energy in Emerging Markets. Highlights from BNEF Frontier Power Analysis", in *BloombergNEF*, 21 November 2017, p. 8, https://data.bloomberglp.com/professional/sites/24/2017/11/BNEF-2017-11-21-Distributed-Energy-in-Emerging-Markets-White-Paper1.pdf.

[57] REN21, *EAC Renewable Energy and Energy Efficiency Status Report 2016*, September 2016, p. 47, http://www.ren21.net/EAC_Report_EN.

[58] See the official website: https://www.lightingglobal.org.

[59] "Mobile Money Transforming Electricity Payment", in *ESI Africa*, No. 1/2018 (April 2018), https://wp.me/p51Z5u-cYD.

[60] Kenechi Okeleke and Xavier Pedros, "The Mobile Economy. Sub-Saharan Africa 2018", cit., p. 9.

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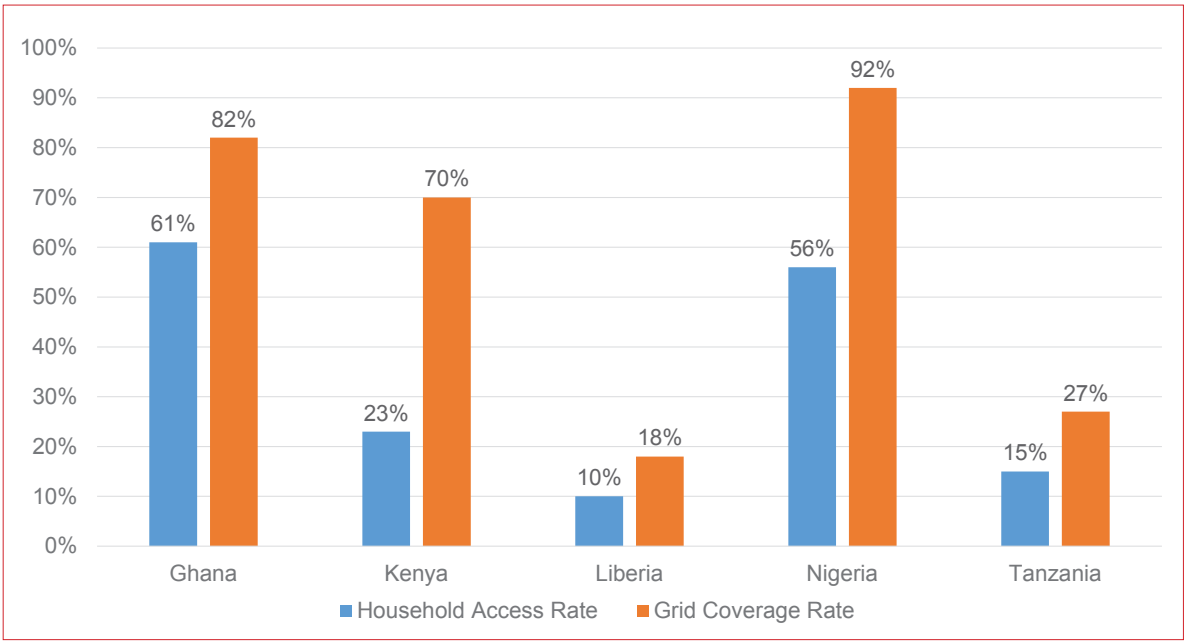
Figure 4 | Household access versus electrical grid coverage



Source: Ben Leo, Vijaya Ramachandran and Robert Morello, "Shedding New Light on the Off-Grid Debate in Power Africa Countries", in *CGD Policy Blogs*, 14 October 2014, https://www.cgdev.org/node/3122295.

Conclusions and policy recommendations

Progress in the electrification of SSA and its technological peculiarities will require a combination of innovative and long-needed actions by the private and the public sectors, with the support of international institutions, to channel the required finance to maintain the current, positive electrification trend. In contrast to how other regions have electrified their countries (China and Europe), Africa will require a different approach due to the lack of domestic funds, the inability to guarantee significant returns to investments, at least in the short term, and to the smaller size of the energy solutions best suited to the African context (particularly off-grid solutions). International cooperation will need to shift towards a backing-up function for private, local, decentralized projects. International institutions need to redouble their efforts to channel private investments through guarantee and financing instruments which aim at reducing and sharing perceived risks, increasing the attractiveness of the sector.

There is a need to empower African consumers. FinTech is positively changing Africa's financial services system, but African governments need to develop policies that help to encourage a consumer culture of using FinTech service and products. At the same time, they need to implement regulatory frameworks that encourage coordination between financial services providers and energy providers, strengthening business cooperation.

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Beyond new tools, it will be fundamental to achieve the long-awaited improvement of the SSA energy sectors by exploiting the current momentum of the African energy sector. This is indeed the time when promoting a transparent and solid business environment, as well as improving the overall governance of the energy industry, will yield the best results.

Lastly, it will be fundamental not to forget that one size does not fit all. Considering the significant diversity of SSA countries, from a geographical as well as economic and demographic perspective, there is not a single "right" strategy that can suit the whole region. In order to improve universal access to electricity in SSA, domestic and international organizations will need to implement policies that consider national specificities without expecting the same results in each country of SSA.

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