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Brief

# Renewables and Gas: What Mix to Solve Sub-Saharan Africa's Energy Access Challenge?

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## Abstract

**FEEM Workshop Brief**

Lack of access to energy represents one of sub-Saharan Africa (SSA) greatest socio-economic challenges. Two out of three people in the sub-continent do not have access to electricity or to modern fuels for cooking. This situation leads, every year, to 600,000 premature deaths due to household air pollution. This situation is unacceptable and unsustainable, and for this reason a new thinking is needed in order to find viable solutions to overcome this issue. Both renewables and gas might play a role in solving this problem, but questions persist on the competing or complementary nature of their relationship. Furthermore, questions persist on how to attract the investments required to guarantee energy access to all. In order to stimulate a discussion on these crucial issues, FEEM 'Energy Scenarios and Policy' program convened on June 16, 2017 in Milan a closed-door brainstorming workshop gathering high-level stakeholders from the institutions, the industry and the academia. This Workshop Brief provides a reflected summary of this discussion, with the aim of contributing to the current international debate on the future of energy in SSA.

# 01 Introduction

More than two thirds of the population of sub-Saharan Africa (SSA) live without access to electricity or modern fuels for cooking. Furthermore, those who do have access to energy often need to cope with a very unreliable service. This not only represents a major barrier to the socio-economic development of the continent, but also a primary cause of death. Around 600,000 premature deaths are, indeed, annually registered in SSA as a consequence of household air pollution resulting from the utilization of polluting fuels for cooking and lighting.

Both renewables and gas might play a role in solving this problem, but questions persist on the competing or complementary nature of their relationship. Furthermore, questions persist on how to attract the investments required to guarantee energy access to all.

FEEM 'Energy Scenarios and Policy' program convened on June 16, 2017 in Milan a closed-door brainstorming workshop to discuss this complex set of issues. The workshop's participants – high-level stakeholders from academia, industry and institutions – particularly discussed the potential for improving energy access in SSA on the basis of renewables and gas.

This Workshop Brief provides a reflected summary of this discussion, with the aim of contributing to the current scholarly and policy debates on the future of energy in SSA.

# 02 Answering SSA's energy access challenge: the role of on-grid and off-grid solutions

Answering SSA's energy access challenge requires a comprehensive action, targeting both on-grid and off-grid solutions.

First of all, SSA's on-grid electricity generation, transmission and distribution infrastructure should be substantially enhanced and expanded. The current on-grid electricity infrastructure is indeed either insufficient and unreliable, as it is reported to be unavailable for about 540 hours per year on average. This is due to several factors like drought affecting hydropower capacity, poor maintenance causing power plants to fall into disrepair, lack of reliable fuel supply and insufficient transmission and distribution capacity. As a

result, blackouts and brownouts are the norm across all SSA countries. In order to meet future electricity demand growth, SSA's on-grid electricity infrastructure has to be reinforced, modernized and expanded. This has to happen at national level, but also at regional level. In fact, developing SSA's four regional power pools (i.e. Southern Africa, Western Africa, Central Africa and Eastern Africa) will be key to fully exploit SSA's vast untapped potential for both large-scale hydropower and gas.

In parallel to on-grid solutions, alternative solutions such as off-grid systems, mini-grid systems and back-up generators represent an increasingly important element of SSA's electricity generation. If diesel-fueled back-up generators are a traditional component of SSA's electricity landscape, new off-grid and mini-grid systems based on solar photovoltaic, small hydropower and small wind are rapidly expanding across the continent. These solutions are very important, as they represent the most viable means of access to electricity for the large rural population that is distant from the grid.

SSA's electricity prices are among the highest in the world. While large utilities can run with deficit as long as they are supported by strong governments (e.g. as the case of India illustrates), this is not the case for private investors. Similarly, while it is undeniable that corruption is a big obstacle to business development, history teaches that energy companies can thrive in very difficult environment. The real risk however, especially when it comes to minigrids, is that competition becomes unfair and local enterprises have to face national utilities and multinationals without appropriate regulatory back up.

Overall, the biggest problem that utilities face in SSA is solvability of custumers – and consequently bankability of projects. To overcome this problem, new business models should be developed. Examples of new solutions are selling a service (e.g. lighting or irrigation) through digital solutions (e.g. fast mobile payments) or utilizing pay-as-you-go schemes for electricity. Digital solutions would not only allow to solve solvability problems, but also to further stimulate innovation, as they allow real-time data collection – which is key for the update of the business models themselves.

Upgrading from stand-alone systems, to minigrids, and finally to grids – a necessary transition to pass from basic services to improved access – represents more of a regulatory than a technical challenge. In fact, among SSA countries it is difficult to find well-defined regulatory frameworks for minigrids.

Another regulatory challenge concerns the 'undergrids', or those who have access to the grid, but cannot use electricity if this is not subsidised. For those, governments should put in place cross-subsidies to balance who consumes more and who consumes less. This would indeed be a smart move, considring that flexible pricing is key to make investments more bankable.

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# Renewables and gas: competitive or complementary solution to SSA's energy access challenge?

Renewables and gas represent a complementary solution to SSA's energy access challenge. This challenge is, indeed, so vast that no silver bullet exist and all possible sustainable solutions should be unleashed.

Considering the high quantity and quality of SSA's solar and wind resources, renewables can offer to SSA countries low-cost and clean electricity either on- and off-grid. However, given the enourmous energy supply required, renewables alone will not be sufficient to ensure energy access to all.

SSA's abundant gas resources represent the perfect match to renewables, as gas could provide a solid back-up to variable solar, wind and hydro (the variability of which will increase with climate change). Furthermore, gas could play a great role in the residential and industry sectors, as well as in the transportation sector.

A renewable-gas tandem would represent a desiderable solution for SSA's energy access challenge even under the environmental perspective. Gas could, indeed, displace coal in electricity generation, allowing immediate and substantial greenhouse gas emissions' reductions. In fact, combined-cycle gas turbines produce about half the CO2 emissions per unit of electricity generated compared with coal-fired plants. Utilizing gas instead of coal would also be positive for the local environment. Nitrogen oxide, sulphur dioxide and particulates emitted by coal-fired electricity plants are notoriously cause of local environmental damages such as acidification, ground-level ozone formation, acid rain and air pollution, particularly at city level.

Gas is a valid alternative to coal also for countries without domestic reserves that are planning for new coal generation. There are different perspectives on the future of coal in Africa. Many countries include coal generation in their energy plans, but there are increasing difficulties in funding coal power generation and coal mining in the continent.

One of the main challenges faced by SSA's energy sector is to scale-up renewable solutions, particularly as long as the cost of new technologies remains high. On this front, China might well emerge as the game changer. In fact, the country will soon find itself dealing with an overproduction of photovoltaic panels that the domestic market will not be able to absorb. Due to its massive presence in Africa, China might quickly increase its export of photovoltaic panel to the continent, scaling-up the utilization of this technology.

The risk is that cheap solar ends up displacing gas instead of coal and that, more broadly, gas and renewable industries remain in competition with each other instead of realizing their synergies. For instance, hybrid gas-renewable systems like integrated solar combined cycle allow to tap into the increasing combined demand of electricity and heat from industry.

# 04 Financing universal access to modern energy in SSA

Scaling-up SSA's energy systems in order to achieve universal access by 2030 – in line with the United Nations' Sustainable Development Goals – will be costly. For instance, it is estimated that expanding SSA's electricity systems to ensure universal and reliable electriciy access by 2030 will cost up to 1.3 trillion US$. In annual terms, this amount translates into a SSA electricity sector's investment requirement of around 70 billion US$ per year by 2030. Ensuring this financing will be challenging, particularly because investment in SSA energy supply remains focused for almost three-quarters on the oil sector, while investment in electricity is limited at around 8 billion US$ per year. In order to reach a good level of universal access to power by 2030, current investments should therefore increase ninefold. This is the enormous size of SSA's energy financing challenge.

Today, the main investors into SSA's energy sector are local public institutions and international energy companies. Among them, Chinese state owned enterprises are the first investor, followed by Italian and French energy companies.

While discussing the financing challenge faced by SSA's energy sector, it is important to make a distincion between stand-alone systems, large projects (e.g. megadams and large transmission lines), and mini-grids.

Stand-alone systems are booming without the need of support from governments nor from international financing institutions, as they use a business model that makes money from selling a service, which is completely different from the usual energy business. Considering the importance of digital finance on this area, their success will practically depend more on the IT sector than on the energy sector.

On the contrary, large, multi-billion, projects do require the involvement of multiple investors and donors, as well as interregional cooperation. While these projects are the most costly, there are different types of financing options available – and there are other factors that affect their feasibility as much as financing, notably environmental and social impact.

Then there are minigrids. Here the business model that seems to prevail is that of business to business between entrepreneurs and users who can ensure long term purchasing of power and therefore constitute an anchor load. In terms of technology, cheap photovoltaic is the most commonly utilised. The minigrid expands starting from these productive users (typically mining) towards neighbouring villages. This is where regulation is needed, but since the infrastructure is already in place, government can already focus on targeted support and subsidies for other users, e.g. farmers and cooperatives. It should be noted that in order for this model to succeed, there needs to be strong businesses who can act as anchor loads, and these are not so common in least developed countries. Interestingly, the support of international financial institutions to local

businesses would indirectly translate in increased energy access.

High resource potential for solar and wind, combined with high availability of land, make large solar and wind farms viable in SSA. However, action is required from governments to create an enabling environment for investments. Over the past 20 years, several SSA countries have put in place targets and supporting mechanisms for building, financing, and operating renewable power generation projects, with mixed results. Overall, while feed in tariffs have proven to be succesful in Europe, these have struggled to achieve the desired outcome in developing countries such as South Africa, where auction systems with competitive tendering have been more succesful – a scheme that has been replicated in other countries, as Namibia.

A competitive market brings tariffs down but, most importantly, investors need guarantees. One example is that of South Africa that used the treasury as guarantor for renewable projects, which gave a lot of confidence to investors. This can be key for large investments, however it may be a highly risky option for poor economies where the treasury is not strong. The above mentioned anchor loading to productive uses seems to be a more pragmatic approach to the problem of grarantee, while at the same time international financial institutions also can (and do) offer guarantees.

While the relationships between financial institutions and investors in renewable energy projects is quite straghtforward (e.g. it is essentially a matter of support on risks mitigation), the relationship of financial institutions with the gas industry is in a more difficult place. Indeed, while solar and wind enjoy the full backing of international financial institutions like the World Bank, they are cautious when it comes to supporting gas - just like it happens for other fossil fuels and large hydropower. However, things may change if it becomes clear that gas can facilitate the transition to renewables.

Another key role that international financial institution can play is to help private investors navigating the complex governance structures of African countries. An example is the ‘Scaling Solar Program’ of the World Bank, which specifically supports investments in grid-connected solar photovoltaic projects.

Overall, foreign investors have the responsibility to deliver projects that benefit the local context beyond the single project. On one hand, this means delivering projects that are environmentally sustainabile, on the other, it means facilitating the creation of local markets. The local manufacturing of renewable technologies in particular is a segment of local content that has so far been largely neglected, but which could well become important to contribute to the long-term sustainabilty of projects.

# Participants to the FEEM workshop

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Thanks to its international network, FEEM integrates its research and dissemination activities with those of the best academic institutions and think tanks around the world.

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