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Africa in Fact

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Russia's energy diplomacy

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ENERGY

An agonisingly slow transition to renewables

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About Good Governance Africa

Good Governance Africa is a registered non-profit organisation with offices in Johannesburg (South Africa), Lagos (Nigeria), Accra (Ghana), Dakar (Senegal), Addis Ababa (Ethiopia) and Harare (Zimbabwe).

We aim to improve governance performance across the continent; to inform and persuade the policy community that transparency and accountability are the basic building blocks of successful development; to strengthen the rule of law; and to build an active citizenry that institutionalises constraints on executive power.

Our publications serve to further these goals. Opinions expressed are those of the individual authors and not necessarily of Good Governance Africa.

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Editorial

Energy for Africa

The figures are staggering. Six hundred million Africans have no access to electricity, making up 75% of the world's 789 million people who live without electricity. The International Energy Agency (IEA) reported these figures in October 2020, warning that without considerable investment and workable policies, the continent will definitely not achieve the UN's Sustainable Development goal (SDG) 7, which aims to ensure that everyone has access to affordable, reliable and sustainable energy by 2030.

Africa's energy deficit (to use a euphemism), which is most apparent in sub-Saharan Africa, impacts on every area of people's lives and is a serious impediment to the continent reaching its development goals, even the longer-term Agenda 2063 set by the African Union itself.

Lack of access, affordability and reliability; all three briefly describe Africa's difficulty in keeping the lights on. The reasons why are many and complex: policy uncertainty, unstable macroeconomic policies, weak legal systems, political instability, a lack of investment, corruption, climate change, and a lack of coherent power sector planning. Governments also insist on pursuing large, hugely expensive but unsustainable infrastructural vanity projects that pollute the environment and look increasingly obsolete in the face of advances made in more affordable and efficient renewable energy. Sub-Saharan Africa's geography is a factor, too; national grids are often simply unable to offer access to remote rural areas.

The issues raised above are just some of the obstacles bedevilling efforts by African countries to provide power to their people. This issue of Africa in Fact seeks to highlight why, in the third decade of the 21st century, 600 million people on the continent are still without access to electricity and what can – and should – be done to remedy this deficit.

In the opening article, Ini Ekott points out that solving Africa's energy problem requires proper funding and policy adjustment, and that off-grid renewable projects, like solar, are the future; they are cheaper and do not require expensive connections to the national grid. It is ironic, he notes, that despite having more solar resources than any other region in the world, Africa has only five gigawatts of solar photovoltaics – less than 1% of installed global capacity.

Nick Branson looks at the role of regional integration in overhauling Africa's energy infrastructure. Regional cooperation, he says, has the potential to

increase market size, making projects more likely to attract foreign investment, enable countries to share surpluses with neighbours, which would make supply more stable and help drive down costs for consumers. He also looks at the power pools already created, such as the Southern Africa Power Pool (SAPP) and the West African Power Pool (WAPP), and unpacks why failings of legal, regulatory and institutional frameworks have led to mixed results.

Interrogating why Africa's energy sector has battled to enter into cost-saving public-private partnerships (PPPs), Fisayo Alo and Eniayo Ibirogba say these have the potential to solve Africa's profound infrastructure and service deficits. Efforts, however, have been limited due to an inability to guarantee investor funds, capacity gaps and few or no regulatory frameworks. PPPs must be protected from fraud and corruption, which are endemic in many African countries, they write.

Dianna Games sets out to explain why, 15 years after Nigeria began a privatisation process, it is still one of the most underpowered countries in the world. A flawed privatisation process, including decrepit infrastructural assets, unrealistically low tariffs and a culture of non-payment among citizens fed up with an erratic supply and unreliable billing, means Nigeria has some tough decisions to make towards a functional energy sector.

Unreliable supply is one reason Nigerians spend $14 billion a year on fuel and generators, writes Amindeh Blaise Atabong, quoting the African Development Bank. As he notes, a reliable electricity supply is key for the functioning of any modern economy. But costly back-up generators are virtually essential for running an enterprise in sub-Saharan Africa, making businesses uncompetitive and distorting the cost of doing business (a 2015 McKinsey report on the African energy sector noted that generator power was on average four times the price of grid power – and would still be two to three times as expensive if grid power in some African countries reflected actual costs rather than benefiting from subsidies).

But there is a more immediate human cost to Africa's energy deficit. Over-reliance on generators and no access to electricity are health hazards. As Barnabas Thondhlana writes, Africa's rural poor are heavily reliant on biomass for cooking and heating, exposing them to high levels of pollutants. Fossil fuel-run generators are air and noise polluters, while the effects of indoor pollution, most often from charcoal and firewood, kills 600,000 sub-Saharans a year. There are other environmental consequences: firewood collection and the charcoal trade have led to devastating swathes of deforestation and environmental degradation.

In other articles, Ronak Gopaldas looks at the pros and cons of nuclear power for Africa, in the context of Russia's aggressive wooing of African governments

to commit to expensive nuclear deals. Egypt has already agreed to a $25 billion Russian loan to build its first nuclear plant.

Water security expert Anthony Turton looks at tensions between Ethiopia and Egypt over the former's filling of its Grand Renaissance Dam on the Blue Nile. However, contrary to outgoing US President Donald Trump's recent suggestion that Egypt could "blow up" the dam, Turton proposes a benefit-sharing network that shifts water, energy and food security from a national to a regional level.

Meanwhile, Ross Harvey's article on Tanzania's Stiegler's Gorge hydropower project in Nyerere National Park, and Grace Wu and Ranji Deshmukh's assessment of Democratic Republic of Congo's Inga 3 dam system, both reveal that the jury is out over the long-term feasibility of legacy megaprojects, given the global move towards cheaper, sustainable options.

All the articles in this issue of AIF emphasise the enormous effort and political will required to power up Africa, but it would be wrong to suggest no progress is being made. Wind and solar power projects across sub-Saharan Africa are proving a viable element of the energy mix, particularly in rural communities, as illustrated by on-the-ground reporting from contributors Munyaradzi Makoni and Blamé Ekoue. Meanwhile, writes Justus Wanzala from Kenya, real efforts are being made across Africa to develop and distribute carbon neutral, affordable alternatives to charcoal and firewood for domestic and commercial use.

Finally, Joe Walsh's article suggests that instead of trying to get everyone onto national grids via projects like Inga with their inevitable financial, political and logistical problems, there's room for decentralised, renewable energy mini and microgrids where geographically and economically appropriate.

It is in this context that it is worth highlighting a June 2020 quote in Ini Ekott's article from Damilola Ogunbiyi, the UN Secretary-General's special representative for Sustainable Energy for All, who said: "There has never been a better time to invest in clean, efficient renewable energy. Countries that recover better [from COVID-19] with sustainable energy will see the pay off in the form of resilient economies, new jobs and faster energy development. By making this investment, African countries can develop a competitive advantage."

Susan Russell
Editor

Energy Africa: overview

Despite recent gains, more people in Africa live without electricity than anywhere else and there is little hope things will change soon

A far from bright future

Ini Ekott

A technician repairs a faulty electrical line in Lagos, Nigeria, 2020
Photo: Pius Utomi Ekpei / AFP

When it comes to access to energy, Africa's figures are noticeably unimpressive. Nearly 75% of the world's 789 million people who lack electricity live in Africa, according to an October 2020 International Energy Agency (IEA) report, and of the 2.6 billion people who lack access to clean cooking, 900 million are in Africa. While the rate of rural electrification in other parts of the world is above 70%, in sub-Saharan Africa it is just above 20%.

There has been progress, however. According to the IEA, the number of people in the continent that gained access to electricity doubled from nine million a year between 2000 and 2013, to 20 million between 2014 and 2018. That gain, however, has been overshadowed by Africa's ballooning population, and many remain without access to power.

"In the past decades, access to electricity in Africa failed to level up with its booming population and this negates the drive for development milestones," said Ubong Edet, director at Open Policy, a development-focused civic group in Abuja, Nigeria.

Attempts by most African nations to significantly increase their citizens' access to electricity over the years largely failed, hampered by policy missteps, poor funding, corruption and sometimes instability. The result is a dysfunctional power sector that has been unable to support economic activities that can create jobs, and education and healthcare services. Only an estimated 28% of health facilities in sub-Saharan Africa have access to reliable electricity, according to Powering Healthcare, an United Nations initiative.

Only an estimated 28% of health facilities in sub-Saharan Africa have access to reliable electricity.

The IEA says unless there is considerable improvement in investment and policies, Africa is certain to default on the global sustainable development goal of 2030 (SDG7), which seeks to ensure access to affordable, reliable, sustainable and modern energy for all. The current policy trajectories will see 530 million Africans still without electricity in the next decade, it says.

"Despite progress in several countries, current and planned efforts to provide access to modern energy services barely outpace population growth," the agency says.

It is an irony for a continent that is the most endowed with raw energy hydro, solar, oil, gas, coal and geothermal resources. Despite having more solar resources than any other region, Africa has only five gigawatts of solar photovoltaics - less than 1% of installed global capacity, says the IEA.

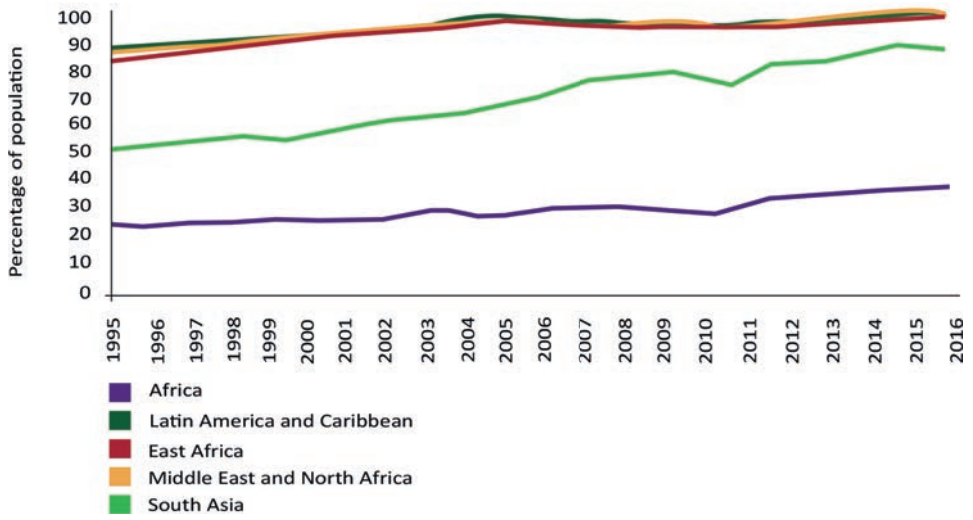
The bulk of the region's energy deficiency is in sub-Saharan Africa, with Nigeria, Ethiopia, Democratic Republic of Congo (DRC), Uganda and Tanzania accounting for the largest number of people without electricity.

Years of efforts by African governments have failed to produce sufficient energy the continent needs for several reasons. The first is the funding gap. The IEA estimates that sub-Saharan Africa needs $35 billion a year to ensure electricity access for all by 2030, and only a few countries have been able to mobilise enough funds locally for their energy projects. Ethiopia, for example, recently raised eight billion birr out of an expected 12 billion birr (about $550 million) for its Grand Renaissance hydroelectric dam through domestic and diaspora bonds.

Corruption is another factor. The anti-corruption group, Socio-Economic Rights and Accountability Project, said Nigeria has spent over $30 billion in the past two decades but has only managed to generate less than 7,000 megawatts of electricity, far less than required by its more than 200 million citizens. It said successive administrations had "squandered" this huge amount without commensurate result.

There is also a policy challenge. Since jumping on the electrification bandwagon in the post-independence days, poor management and a lack of political will have seen many African countries end up with white elephant energy projects. In contrast, Asia has, through the same period, accelerated its

Access to energy



Source: World Bank

electrification and achieved the most significant decline in the number of people without electricity worldwide between 2010 and 2018.

Africa's modest improvement has been in East Africa. Here, Kenya, Ethiopia and Tanzania account for more than half of those gaining access to electricity, according to the Brussels-based Alliance for Rural Electrification. In Kenya, the electricity access rate rose triple fold within five years to 75% in 2018 as the country complemented grid connections with solar and geothermal systems.

Even with such progress, as of July 2020, only one country in Africa – Gabon – was "on track" to achieve SDG7, according to an analysis by the Sustainable Development Goals Center for Africa and the Sustainable Development Solutions Network. Twenty-two countries were "moderately increasing", 28 were stagnating while three countries were "decreasing".

African countries appear better on track to attain the more drawn out African Union's own goal that seeks to harness, by 2063, all "African energy resources to ensure modern, efficient, reliable, cost-effective, renewable and environmentally friendly energy to all African households, businesses, industries and institutions."

"Africa will have to raise its funding and actionable plans if it will ever meet up with the rest of the world developmentally in the coming years," said Edet of Open Policy.

Access to electricity in Africa is also hampered by affordability and reliability. The unit cost of electricity to consumers in many African countries is more than double the cost

A woman disconnects her electricity counter in a bid to save money inside the courtyard of a workers' quarter in Dakar, Senegal
Photo: Geaorge Gobet / AFP

in developed nations such as the United States, according to a joint assessment by Agence Française de Développement and the World Bank.

Also, even in instances where power is available, households spend hours without power. In 25 of the 29 countries in Africa examined by a World Bank report, fewer than one-third of firms had reliable access to electricity. Things worked relatively better in Liberia, Namibia, and South Sudan than in Nigeria, Kenya, Mali, and Tanzania, the report said.

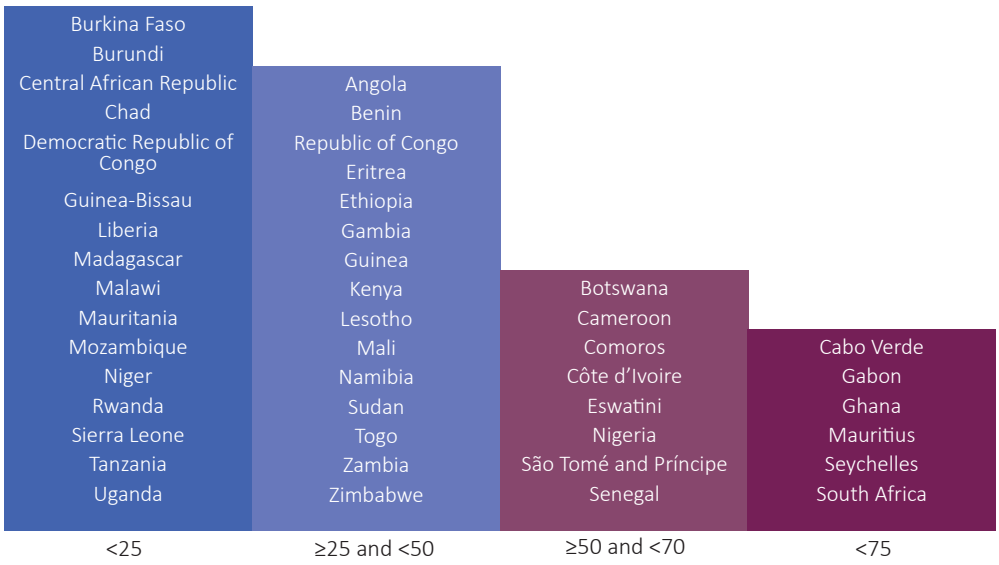
Solving Africa's energy problem requires proper funding and policy adjustment. Experts say off-grid renewable projects, like solar, should be Africa's energy future because they are less costly and do not require expensive connections to the national grid, especially since the majority of the population reside in rural areas.

First, African countries will have to quadruple their rate of investment in their power sectors for the next two decades to bring reliable electricity to all Africans, the IEA said. The agency recommends an annual investment of around $120 billion yearly to bring electricity to all in Africa.

"We're talking about 2.5% of GDP that should go into the power sector," Laura Cozzi, the IEA's Chief Energy Modeller, said in November 2019. "India's done it over the past 20 years. China has done it. So, it's something that is doable."

Given the cost, the agency recommends using more mini-grids and says attention should be focused more on the huge potential that solar, wind, hydropower, and natural gas offer.

Households with electricity, latest available data (%)



Source: World Bank

Despite evidence that solar and wind could provide cheaper and more environmentally friendly options to expand electricity in Africa, a number of African nations are shifting to nuclear energy. They cite the threat of drought to hydropower and argue that nuclear power can provide a reliable support for renewables such as solar and wind.

In addition to South Africa, which has Africa's only nuclear power plant, Ghana, Morocco, Egypt, Kenya, Nigeria, Niger, Tunisia, Algeria, Zambia, Uganda and Sudan have considered adopting nuclear energy, according to the International Atomic Energy Agency.

Norbert Edomah, an energy expert and senior lecturer at the Pan-Atlantic University, Lagos, says countries should adopt options that work best for them and should consider "contextual energy geography".

"What works in East Africa may not work in West Africa," he told *Africa in Fact*. Edomah advised policymakers to pay attention to "providing energy for productivity".

"The question to ask is, what do people use energy for? In what way can we provide energy to improve livelihoods? Things that focus on livelihoods and improve productivity is what we should focus on," he said.

There is an immediate constraint. The IEA fears the COVID-19 pandemic may reverse years of progress made in expanding access to electricity. It says that as governments attend to the immediate public health and economic crisis, utilities are bound to face serious financial strain. Also, increased poverty levels worldwide in 2020 may make basic electricity services unaffordable.

But Damilola Ogunbiyi, CEO and Special Representative of the UN Secretary-General for Sustainable Energy for All (SEforALL) and co-chair of UN-Energy, said the pandemic also provided an opportunity that could be harnessed.

In a statement to launch SEforAll's *Recover Better with Sustainable Energy Guide for African Countries* in June 2020, Ogunbiyi said, "COVID-19 has changed the world as we know it. As countries rebuild economies impacted by the pandemic, they are faced with a unique, once in a generation opportunity to 'recover better' with sustainable energy.

As countries rebuild economies impacted by the pandemic, they have the unique opportunity to opt for sustainable energy.

"There has never been a better time to invest in clean, efficient renewable energy. Countries that recover better with sustainable energy will see the pay off in the form of resilient economies, new jobs, and faster energy development. By making this investment, African countries can develop a competitive advantage." GG

Power lines leaving the Eskom Duvha power station, east of Witbank, in the coal rich Witbank region of South Africa
Photo: Marco Langari / AFP

Africa: regional integration

Africa's collective power supply is bedevilled by weak legal frameworks and regional rivalry

The struggle to keep pace

Nick Branson

An estimated 580 million Africans lack access to electricity, three quarters of the global total. The International Energy Agency (IEA) expects this number to rise as the COVID-19 pandemic stalls efforts to keep up with rising demand. Before coronavirus struck, the continent had been making slow progress towards Sustainable Development Goal 7 – Ensuring access to affordable, reliable, sustainable and modern energy for all – but it now stands little chance of meeting this target by 2030.

Despite extensive petroleum reserves, high solar irradiation levels and vast hydropower potential, Africa receives only 4% of global energy supply investment, according to the IEA. This is largely a result of foreign investors' fears that short-term political considerations will trump long-term policy goals, rendering energy master plans obsolete. Investors' primary concerns include abrupt changes to the policy environment, unsustainably low electricity tariffs dependent on unaffordable state subsidies, and the poor governance and creditworthiness of state-owned utility companies. A whopping 95% of African energy utilities fail to recover their costs, according to the Energy for Growth Hub, scaring off potential investors.

Regional cooperation on energy promises potential solutions in three key areas. First, cross-border partnerships increase market size, making projects more likely to attract foreign investment. Second, regional connections enable countries with surplus electricity to share it with neighbours experiencing shortfalls thereby making power supplies more reliable. Third, a regional market can help drive down the costs for consumers if utility companies are mandated to purchase the cheapest available power. All three trends help to promote a shift in the energy mix by maximising the potential of new renewable sources at the expense of older and inefficient thermal generators.

Africa's regional economic communities have already taken steps to integrate through power pools, which enable national utility companies to plan and operate their collective electricity supply and transmission in the most reliable and economic manner given their load requirements. These power pools have the potential to promote investment in new hydropower capacity, reducing power system operating costs by $2.7 billion each year, and carbon dioxide emissions by 70 million tonnes per annum, according to estimates by the World Bank.

The Southern African Development Community (SADC) was the first regional economic community to connect national electricity grids and form a common market for electricity, establishing the Southern Africa Power Pool (SAPP) in 1995. Rising power demand in South Africa and at energy-intensive mining projects elsewhere in the region helped to attract foreign investment. This led to the creation of the Copperbelt Energy Corporation, a private Zambian electricity generation, transmission, distribution and supply company, in 1997, and Motraco, a joint venture between Mozambique, South Africa and Swaziland to upgrade cross-border transmission lines in 1998.

This early progress spurred the signing of bilateral contracts between the member countries, followed by the development of a Short-Term Electricity Market in 2001 and a Day-Ahead Market in 2009. By 2010, 7.5% of power generated in the region was being traded across the SAPP, according to the Infrastructure Consortium for Africa. However, this early progress in trading was not accompanied by comparable attention to the institutional environmental. SADC failed to establish an independent regulator to oversee compliance with technical codes, regulate prices and promote competition. The weak legal framework and the absence of an autonomous dispute-resolution body undermined the pool's prospects, according to a report commissioned by the World Bank.

Regional rivalry also undermined SAPP's prospects, with SADC energy ministers unable to agree a list of priority projects, thus missing opportunities to secure new investment in power production during the 2000s. Uneven

development left members overly reliant on Eskom, the utility company in regional hegemon South Africa, which had both the most installed capacity and was the top buyer of surplus electricity. A wave of power cuts in South Africa forced other members of the pool to implement load-shedding from 2008 onwards. Rather than address this challenge President Jacob Zuma mismanaged Eskom, leaving the utility company overstaffed and broke, undermining its ability to honour contracts through SAPP.

The Economic Community for West African States (ECOWAS) was more pragmatic than SADC when it established the West African Power Pool (WAPP) in 1999. Recognising the chronic energy shortages which plagued the region's economic engine, Nigeria, WAPP adopted a more pragmatic, two-tier approach. Where reliable connections existed, steps were taken to forge a common market for electricity. Bilateral power purchase agreements enabled Côte d'Ivoire to export surplus energy to neighbouring Ghana, which was grappling with power cuts, and onwards to Benin and Togo, which as small countries had struggled to secure investment in their grids. By 2010, 6.9% of power generated in the region was being traded across this bloc, according to the Infrastructure Consortium for Africa.

By 2010, 6.9% of power generated in the region was being traded across the WAPP bloc.

Where reliable connections were lacking, the focus was on linking the hinterland to more developed coastal nations. Thus, inland Burkina Faso gained access to power from Ghana and Côte d'Ivoire, while Niger was hooked up to Nigeria. But a number of smaller economies remain left behind, with laggards Guinea, Liberia, Mali and Sierra Leone still busy aligning their systems in the hope of accessing cheaper energy supplies from elsewhere in the WAPP. Other countries have forged their own path. Senegal initially cooperated with Mali and Mauritania to share hydropower from the Manantali dam, but President Macky Sall has since focused on upgrading his country's installed capacity and grid, eyeing abundant offshore gas reserves. This threatens to leave Senegal's smaller neighbours Guinea-Bissau and Gambia in the dark.

While the WAPP's approach risks exacerbating regional inequality, it has at least developed a more robust framework, including a stronger and more autonomous secretariat capable of promoting priority projects and finalising decisions rather than waiting for national governments to act, according to a report commissioned by the World Bank. ECOWAS also took the critical step of establishing a Regional Electricity Regulatory Authority (ERERA), which became operational in 2011, addressing the lacuna identified in the SAPP.

The thermal power station of Côte d'Ivoire's electricity production company Ciprel in Abidjan
Photo: Sia Kambou / AFP

In the middle of the continent, the Economic Community of Central African States (ECCAS) has failed to emulate ECOWAS' dynamism through the Central Africa Power Pool (CAPP), which it founded in 2003. Hugely ambitious plans to build new transmission lines required to unlock the vast hydropower potential of the River Congo have yet to move beyond the drawing board, with neither donors nor the private sector willing to tackle myriad political, regulatory, macroeconomic and security risks.

Greater hope lies in the Eastern Africa Power Pool (EAPP), which was formed by seven Common Market for Eastern and Southern Africa (COMESA) members in February 2005. Although the World Bank dismissed regional energy trade as "negligible" less than a decade ago, investment in new dams and transmission lines promises to make Ethiopia and Kenya major electricity exporters. While Kenya has mastered geothermal power from the Rift Valley,

Ethiopia is doubling its installed generation capacity courtesy of the 6,000 MW Grand Ethiopian Renaissance Dam (GERD), which is expected to become fully operational in 2023. Such vast potential convinced the World Bank and African Development Bank to fund a new 2,000 MW transmission line between the two countries, which was completed last year. The GERD promises to lower electricity costs, transform the energy mix and make power supplies more reliable across EAPP.

COMESA has also moved to establish common legal, regulatory and institutional frameworks. In 2012, the EAPP established an independent regulatory board to supervise the pool, ensure compliance with electricity codes and technical standards, and regulate the use and price of transmission lines. The regulator also plays a role in enforcing standards and resolving disputes, helping to encourage private investment, thus promoting competition in the pool progressively. For now, the focus is the Day-Ahead Market, but the EAPP aims to move to a centralised trading regime in the next five years, according to the Infrastructure Consortium for Africa.

However, Francois Pienaar, Business Development Manager at ESB International and a former consultant to utilities in Ghana, Liberia and Tanzania, worries that "billions spent on interconnections will be wasted" without greater attention to regional integration. Too many African governments focus on short-term objectives, such as subsidising electricity to key electoral constituencies to retain their political support, rather than considering how to address the contingent financial liabilities of national utility companies. Moreover, the energy sector has to vie for attention with competing industries, including the transport sector, beloved by politicians seeking visible projects.

Too many governments focus on short-term objectives rather than addressing the financial liabilities of national utility companies.

The outlook is also complicated by COVID-19. "A crisis can often predispose policymakers to undertake more politically risky energy sector reforms", Alan David Lee and Zainab Usman note in their World Bank paper, *Taking stock of the political economy of power sector reforms in developing countries*. Yet Dr Usman told *Africa in Fact* that "the coronavirus pandemic has dramatically increased fiscal pressures in ways that could make African governments subordinate electrification projects to more urgent priorities". The strengthening of Africa's power pools therefore looks to be among the many casualties of the current public health emergency, increasing the number of Africans deprived of access to electricity. GG

Lights on: PPPs

Africa's involvement in PPPs has been limited largely due to an inability to guarantee investor funds and gaps in capacity

The role of public/private partnerships

Fisayo Alo and Eniayo Ibirogba

Africa is home to about 1.3 billion people. It is the second-largest and second most populous continent in the world. The abundance of resources notwithstanding, the continent remains under-developed and very little of these resources have translated into sustained economic growth for the majority of people. Africa is food-insecure in spite of having vast areas of arable land, many lack access to safe water, health, education and energy. Energy is central to poverty reduction efforts and the sustainable development of Africa.

The solar energy power plant in Zaktubi, near Ouagadougou in Burkina Faso
Photo: Ludovic Marin / AFP

According to the International Finance Corporation (IFC), energy is a broad sector that holds two important yet very different industries: the oil and gas sector, and the power sector. Access to energy is essential to close development gaps in emerging markets. It underpins the investments, innovations, and industries that drive inclusive growth, create jobs and markets. It strengthens economies, enhances basic human needs, such as food and shelter, and improves education and public health.

Africa's development is directly dependent on her ability to meet her energy needs. The African Development Bank (AfDB) has estimated that Africa needs at least $170 billion a year by 2025 to finance her infrastructure needs, with a financing gap of $68 to $108 billion a year. The United Nations Economic Commission for Africa (UNECA), in its 2011 Africa Infrastructure Country Diagnostic (AICD), said that over a 10-year period, as much as $48 billion in new investment is needed annually in Africa to make up the spending shortfalls in all infrastructure sectors. But $29 billion, or 61% of that total, is needed in the energy sector.

With at least 600 million Africans living without access to electricity, billions of dollars are needed for energy related projects. Sustainable Thermal Energy Partnerships (STEPs), a project sponsored by the United Kingdom's Department for International Development, revealed that Africa's energy capacity and infrastructure have developed at a far slower pace than economic growth. It found that the rate of electrification access in Africa is less than half of other developing regions such as South Asia and Latin America.

The lack of investment in energy in Africa is evident in Nigeria. With a population nearing 200 million, the country only has an installed electricity capacity of some 8,500 megawatts providing a per capita 150 kilowatts annually. This is far less than countries with considerably smaller GDPs, such as Cameroon (256), Côte d'Ivoire (212) and Gabon (907). Across Africa, Private-Public Partnerships (PPPs) are increasingly seen as an essential mechanism to finance infrastructure facilities hitherto provided by the public sector. The *African Journal of Management* (AJM) has described PPPs as cooperative arrangements between governments and multinational corporations that are created to finance, construct and manage infrastructure projects. Constraints on public sector resources, growing pressure on government budgets, and concerns about the efficiency of services provided by the state have led to many governments stepping up their efforts to encourage partnerships with the private sector. To radically improve infrastructure networks and enhance service delivery, governments are looking to PPPs.

Much of the success of a PPP derives from the strengths of both the private and the public sector to provide an efficient and cost-effective public service

and ramp up implementation and/or coverage. The drivers of PPP growth on the continent include increased efficiency in project delivery and operation; reinforcing competition; access to advanced technology; and reducing government budgetary constraints by accessing private capital.

Across the region, government is latching on to PPPs. Between the years 1990 and 2008, approximately 360 infrastructure projects were implemented using private participation in sub-Saharan Africa with a combined value estimated at around $70 billion. Recently, in March 2020, the International Finance Corporation (IFC) committed $750,000 to Comasel de St Louis, Senegal, a wholly-owned subsidiary of Morocco's electricity utility, the Office National de l'Electricité, for a project that will use a mix of grid connections and individual solar kits to bring power to 20,000 rural households in 300 Senegalese villages. There is also the Gurara Hydro Power Project (30MW) concession in Kaduna, Nigeria, a 25-year Operate and Maintain PPP project by North South Power Company Limited, which began on 12 May 2020.

In Cameroon, the Kribi Gas-fired plant project is part of a medium-term strategic development programme for the supply of electricity to the country, which is designed to meet growing electricity demands. Comprising a 216 MW gas-fired power plant and a 100 km long 225 kV transmission line, the $400 million project is co-owned by the private AES Corporation (56%) and the Republic of Cameroon (44%).

Meanwhile, in Mozambique, UK company Aggreko and its local joint-venture partner Shanduka Group, has opened and delivered power from its 107.5 MW interim gas-fired power plant at Gigawatt Park in Ressano Garcia. The project is a Power Purchase Agreement (PPA) that Aggreko signed with Electricidade de Moçambique (EDM), the Mozambique power utility, and the country's South African counterpart, Eskom.

Kenya's Thika Power Plant Project consists of the development, design, construction and operation of a Greenfield 87 MW heavy Fuel Oil (HFO) diesel power plant on a 20-year Build-Own-Operate (BOO) basis about 35 km from Nairobi. Thika Power is a subsidiary of Melec PowerGen Inc., an affiliate of the Matelec group of companies from Lebanon.

Theoretically, PPPs may have the potential to solve Africa's profound infrastructure and service deficits.

Theoretically, PPPs may have the potential to solve Africa's profound infrastructure and service deficits. In comparison to other continents, Africa's involvement in PPPs has been limited, largely due to an inability to guarantee investors' funds and gaps in capacity. It is also imperative that a clear institutional framework be put in place. This

framework will be a critical factor in the success of PPPs and would help with defining roles for regulation, preparation, assessment, supervision, monitoring and evaluation. States must strengthen the institutions of governance. One way to achieve this is by passing laws that guide the actions of state institutions. This would make it harder for government agencies that are critical to the success of PPPs to be weakened by political interference.

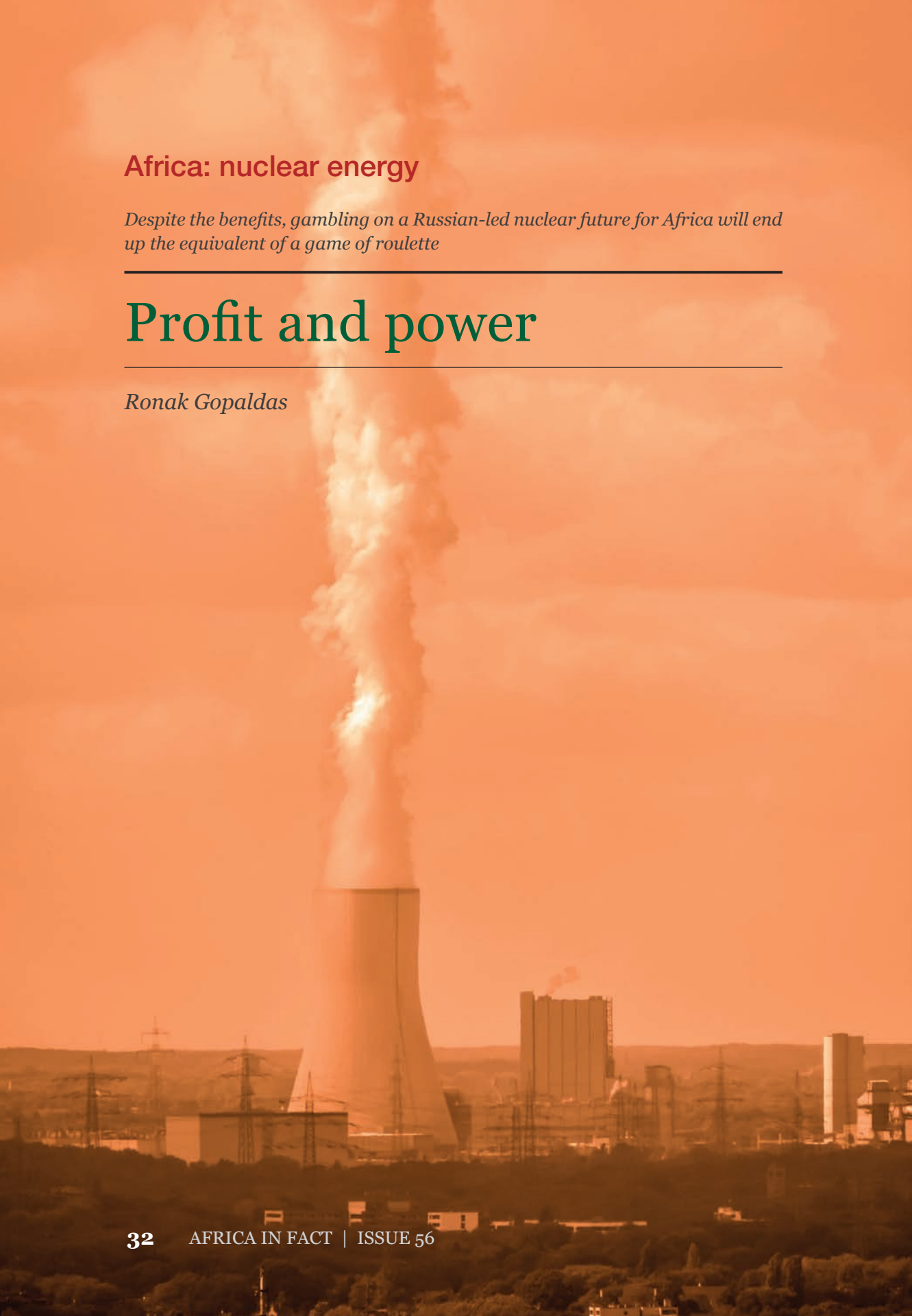
States must strengthen the institutions of governance by passing laws that guide the actions of state institutions.

Nigeria's Minister of Works, Babatunde Fashola, alluded to this at the Lafarge Africa Concrete Ideas virtual meeting held on 13 October 2020, stating that legislation like this was of paramount importance in effectively implementing PPPs, and citing the example of Nigeria's Infrastructure Concession Regulatory Commission (ICRC), which was established in 2008 by an act of parliament to regulate the federal government's PPP endeavours. This aims at addressing Nigeria's physical infrastructure deficit, which hampers economic development. PPP investments must be protected from fraud and corruption, which are endemic in many African countries.

On what should Africa focus? Against this background, and as many governments look to seal PPPs that guarantee win-win situations, policymakers and government deal makers must appreciate the need to have watertight deals, at least to save the government from any financial loss and embarrassment. The PPPs adopted by states may differ, depending on focus as well as political and economic goals. Emphasis needs to be on fiscal benefits, the efficiency gains of the private sector, and the development of local financial markets.

There should be concerted efforts to address identified challenges, including unstable macroeconomic policies, weak legal systems, absence of a clear policy framework, lack of (transparent, consistent, and fair) regulations, absence of coherent power sector planning, little or no cost-reflective tariffs, political risks, and poor operational practices. Governments must pursue bankable projects that are capable of attracting private sector investors. They cannot be a regulator and an actor within the energy sector at the same time. Governments should allow market forces to drive prices and service delivery, and only ensure that the right regulatory environment for effective and quality service delivery is guaranteed. GG

The Sere wind farm, 350 km from Cape Town, South Africa, consists of 46 turbines, each producing 2,3MW of electricity. It is managed by Eskom, the South African government parasatal charged with electricity supply, and was built by Siemens
Photo: Rodger Bosch / AFP



Africa: nuclear energy

Despite the benefits, gambling on a Russian-led nuclear future for Africa will end up the equivalent of a game of roulette

Profit and power

Ronak Gopaldas

Russia is becoming increasingly aggressive in attempts to exert its influence in Africa, and nuclear energy is an area in which they are making major inroads. With Africa's energy deficit and Russia's comparative advantage in this field, advocates suggest this is an approach which could deliver win-win solutions for both parties. However, this is not a view that is universally held. The debate therefore continues to rage around whether the nuclear approach is simply pragmatic, or whether it is dangerous, unsuitable and a potentially damaging option.

Answering this question effectively requires a nuanced understanding of a number of intricately linked, complex factors. Namely, the continent's energy needs; the pros and cons of nuclear energy; how Russian energy diplomacy works in practice, and the strategic rationale for Africa to pursue this avenue. By assessing the currents state of affairs, alongside past progress and future prospects, a clearer understanding of the potential and pitfalls of this approach is possible.

First, it is important to understand the continent's energy deficit. Despite being home to some 20% of the world's population, Africa currently accounts for just 4% of global power supply investment. Only 40% of Africans have access to electricity, leaving 600 million people in the dark.

According to the International Energy Agency's Africa Energy Outlook 2019, the global population without access to energy will become increasingly concentrated, with 90% without access to electricity and almost 50% without access to clean cooking in 2040 living on the African continent.

The status quo is clearly untenable, especially in light of the continent's evolving demographics. Simply put, today's policy and investment plans are still not enough to meet the energy needs of Africa's growing population.

With over 1,000 gigawatts of additional power urgently required to address this power gap, the need for cheaper, more sustainable energy alternatives has become urgent. In this context, the search for new sources, partners and strategies is accelerating.

Recently, a number of African nations decided to pursue nuclear power industries or are currently considering this option. Africa is largely virgin territory for this mode of energy. Indeed, at present there is only one operational nuclear power plant in South Africa, representing the full extent of the continent's functional nuclear capacity. However, this is changing fast.

Egypt has accepted a $25 billion loan from Russia to build Dabaa, the country's first nuclear power plant. The Russians have committed to supply nuclear fuel for the plant throughout its entire lifetime, be involved in the maintenance of the plant and in the training of Egyptian personnel for the first decade of operation.

Russia's President Vladimir Putin and Egypt's President Abdel Fattah al-Sisi at a press conference following the 2019 Russia-Africa Summit at the Sirius Park of Science and Art in Sochi, Russia
Photo: Sergei Chirikov / AFP

countries is starting to grow. To be sure, Russia is a major player in the nuclear market. It accounts for 7% of world uranium production, 20% conversion and 45% enrichment of this element, as well as for the construction of 25% of nuclear power plants in the world.

Russia's energy diplomacy, which centres on two imperatives – profit and power, is the primary avenue used to achieve this. The Russian government, and more specifically Rosatom, has been used to woo African nations into making deals.

Russia's energy diplomacy is centred on two imperatives – profit and power.

For Russia, Africa is too big to ignore and an important partner in a changing global geopolitical landscape in which it is looking to assert itself as a dominant power. This theme was strongly emphasised during the 2019 Russia Africa summit in Sochi, which was billed as the start of a new era of Russo-Africa relations.

Understanding Russia's broader strategic aspiration in Africa requires understanding the broader geopolitical context. Historically, Russia and many African countries' leaders share close ties and existing relationships to lever as a result of the assistance Russia offered during the time of African independence and the Cold War. African states are of strategic interest to Russia in terms of the geopolitical support they can offer; African states comprise the biggest geographic voting bloc across a multitude of global diplomatic, security and economic institutions and organisations.

There is a broader economic imperative behind this rapprochement, too. As Aailya Vayez notes in her August/September 2020 paper on the evolving nature of Russia-Africa relations for *The Republic*, "the looming prospects of shrinking national natural resource reserves have extended into the country's nuclear sector, with uranium reserves in shortage. Uranium extracted from African countries, such as Egypt, South Africa and Namibia, has become a significant raw material for Russian nuclear companies. This has gradually pushed Russia to become an importer of many raw minerals."

Meanwhile, African countries see Russia as a partner that is not morally, politically or otherwise prescriptive. Russia's trade and investment in Africa without conditions or imposition of ideals means that African countries view Russia and the related relations in a positive light – opening the way for further economic interactions.

African countries see Russia as a partner that is not morally, politically or otherwise prescriptive.

For African countries that lack financing to enhance energy infrastructure, the value proposition around nuclear is clear. Rosatom provides cheaper products than its competitors, is ready to loan money for construction and take care of the disposal of nuclear waste, and, in the conditions of constant blackouts, the continent needs uninterrupted, environmentally friendly and inexpensive electricity supplies as never before.

However Russian engagement is not without risks.

What African economies stand to gain in terms of huge investments into cheap and reliable electricity, and increased access to global markets and economic opportunity, may undermine governance and lead to a potential loss of institutional oversight. The recent headline grabbing nuclear deal proposed between Russia and South Africa is a clear example of the secrecy and lack of transparency associated with such transactions. It was only after strong pushback from South African civil society, independent media and robust institutions that the deal (which made very little commercial sense) was aborted. However, other countries with less sophisticated systems and weaker institutions may be less lucky and fall victim to such malfeasance.

Building nuclear plants with Russia would also open up those African nations to the vagaries of energy diplomacy relations with the country, which if evidence with Europe is anything to go by, could carry disastrous consequences. Indeed, if things turn sour, political displeasure could be expressed in unconventional ways – as was evidenced when Russia shut off gas supplies to Europe during the winter of 2015. Load shedding via Russia may become a reality for African

countries who fail to manage their arrangements pragmatically and who enter into lopsided, unfavourable deals. For average citizens, the opacity around these government-to-government contracts should be carefully monitored.

Then there is the issue of debt. To contextualise, over the past 20 years, Moscow has written off $140 billion to foreign borrowers, of which $20 billion came from African states. The persistent pushing of expensive nuclear projects in countries with a bad credit history suggests that there may be a political motivation overriding economic calculations. African countries need to be careful of ending up on the wrong side of exploitative practices, which are not mutually beneficial and could saddle them with unanticipated budgetary consequences. A more streetwise approach is therefore needed.

Finally, there are concerns around the capacity of African states to manage these entities and questions on whether nuclear is actually fit for purpose. Insufficient infrastructure and a lack of human resources are key constraints which would hobble the success of such endeavours. Deep technical skills and experience is required to run such reactors – unfortunately these are not in high supply on the continent.

In theory, if managed sensibly, nuclear energy could be a game changer for the continent. Indeed, the peaceful use of nuclear energy could act as an instrument to achieve national, African (Agenda 2063) and international development goals such as the UN Sustainable Development Goals (SDGs).

Sound governance and management will be needed to prevent sub-optimal societal and economic outcomes.

However, there are a number of important caveats to this. Given the dangers associated with this mode of energy, sound governance and management will be needed to prevent sub-optimal societal and economic outcomes. Here, co-ordination and sequencing will matter, as will the need to "strengthen relevant bodies responsible for nuclear governance on the continent, improvement of national-level legislation on nuclear safety and security, and promotion of public debate on these issues", as noted by the South African Institute of International Affairs' (SAIIA) Atoms for Development project.

In the absence of these measures, gambling on a future in nuclear will end up being the equivalent of a game of Russian roulette – both literally and metaphorically. The rewards may simply not be worth the risk. GG

A roadside mechanic repairs electricity generators that are believed to contribute to the environmental pollution in Port Harcourt, Nigeria
Photo: Pius Utomi Ekpei / AFP

Generators: supply and demand

Forced to use generators to supplement erratic power supplies is a heavy burden for African businesses

A high price to pay

Amindeh Blaise Atabong

Menye Ndzana, a welder-cum-musician popularly known as Le Grand Barack, suddenly rose to national prominence in Cameroon in the wake of the 2018 presidential election when he took to social media to vent his anger. His pent-up frustration was due to a lack of power to run his small welding workshop in the Elig-Mfomo community, some 64 km north-east of the capital, Yaounde.

Le Grand Barack had just voted for the then 85-year old Paul Biya, enabling the president to extend his 36-year rule by another seven years. But Le Grand Barack had a fundamental problem – intermittent power supply was turning his life upside-down and depriving him of a livelihood. "I did not know it was going to be like this. Because of Eneo [Energy of Cameroon], we are suffering," Le Grand Barack exclaimed back then, unable to fulfil orders placed at his welding workshop for lack of electricity. He regretted voting for Biya whose policies over the years have not guaranteed a steady supply of electricity.

Following his outcry, Le Grand Barack was gifted a 5.5 kVA fuel generator. It was a relief, but the welder has since had financial difficulties with running the generator.

Generators are a common feature in next-door Nigeria – Africa's largest economy. Most enterprises own them to address regular electricity blackouts. But the widespread use of generators is potentially damaging. The World Health Organization estimates that 4.2 million people globally in both rural and urban areas met an untimely death in 2016 alone due to outdoor air pollution linked to combustion, including generators.

WHO estimates that 4.2 million people globally met an untimely death in 2016 due to indoor air pollution linked to combustion.

The rampant use of back-up generators is also a substantial source of noise pollution. The situation is so acute that Nigerian superstar singer and songwriter Tekno captured it in his 2016 hit song *Rara*, writing "Generator wan tear my ear."

Despite their negative impact on health and the environment, the reliance on generators remains essential in keeping businesses running in a continent chiefly marked by poor and/or unreliable power supply. According to a 2019 report, *Electricity Access in Sub-Saharan Africa*, produced by the World Bank and the French Development Agency, only two-fifths of sub-Saharan Africa's population has access to electricity. Over 600 million people on the continent remain without electricity, including more than 80% of those living in rural areas. This makes Africa the region with the lowest rate of access to electricity in the world.

According to Samuel Ayokunle Olowosejeje, a PhD researcher at University College Cork in Ireland, Africa still struggles with power supply – despite its enormous energy potential - due to the absence of energy policies or ineffective energy policies when they do exist. He also blames the poor and/or unreliable power supply on the lack of a maintenance culture, inadequate regulations and the inability to enforce regulations as well as the mismanagement of funds and operations usually stemming from corruption, technical ineptitude and technology paucity, among others.

"Sub-Saharan Africa's electric power supply-to-demand shortfall has been widely documented. The electrification rate of most sub-Saharan African countries, excluding South Africa, is less than 30%, with an average electrification rate of 16% in rural communities. The paucity of electricity supply in the region is quite alarming," Olowosejeje told *Africa in Fact*.

Experts are unanimous that reliable electricity supply is key for the functioning of any modern economy, especially with the advent of the digital revolution. Yet, the reliability of electricity supply remains a big hurdle in Africa, with firms experiencing outages outnumbering those in any other region. "We found that unreliable power can have a major impact on businesses, dampening their growth prospects and undermining job creation opportunities," says Vijaya Ramachandran, senior fellow at the non-profit think tank Center for Global Development.

A reliable electricity supply is key for the functioning of any modern economy.

World Bank data shows that on average each year, countries in sub-Saharan Africa experience between 50 hours and 4,600 hours of power outage, amounting to more than half a year in some countries. Last year, 78% of firms operating on the continent reported having experienced power interruptions, 41% of which considered these blackouts as a major constraint to their business operations.

Considering that back-up generators are actually deployed in 75% of places which are grid-connected, this inflicts substantial financial and non-monetary cost on businesses, individuals, and the environment. For instance, in Nigeria, which tops the list of countries using diesel and gasoline back-up generators in Africa, citizens spend $14 billion on fuel and generators yearly, according the African Development Bank. The International Monetary Fund (IMF), meanwhile, asserts that limited access to electricity and unreliable power supply is a major setback to doing business in Nigeria and estimates the West African country loses $29 billion each year because of that.

A tailor uses a generator for power due to the epileptic public power supply in Lagos, Nigeria, September 2016
Photo: Pius Utomi Ekpei / AFP

The International Finance Corporation in its September 2019 report, *The Dirty Footprint of the Broken Grid*, highlights that generators gulp some 20% of the gasoline and diesel consumed in sub-Saharan Africa at a cost of approximately $28 billion to $50 billion every year. The IMF points out that this amount translates to an average service cost of $0.30/kWh for the fuel alone (ranging from $0.20/kWh to $0.60/kWh depending on generator size and fuel type), generally much higher than the cost of grid-based energy ($0.10–0.30 /

kWh). Besides, there is also a cost associated with running and maintaining generators, that can add an extra 10-20% to fuel service costs.

Related data from the 2018 World Bank Enterprise Survey, which included 139 economies, unveils an indirect cost associated with poor and/or unreliable power supply. It indicates that unmitigated estimated outage costs range from $2 to $32 per kWh, depending on the level of a firm's vulnerability to power interruptions. Also, the data shows that the estimated back-up (self-generation) cost in Africa is $0.47/kWh, approximately three times higher than cost-reflective tariffs of grid-supplied energy in countries like Nigeria (~$0.15/kWh) and Uganda ($0.17/kWh).

The World Bank's *Electricity Access in Sub-Saharan Africa* report points out: "The results of the estimation show a strong negative effect of outages on the value-added output and productivity of firms in the region: for every percentage point increase in the frequency of electricity outages experienced by firms, real value added (output) declines by 3.3%. Similarly, the effect on firms' revenue is nontrivial, given that a percentage point increase in outage frequency results in a 2.7% loss in firm revenue."

To reverse the tide and find lasting solutions that could improve the continent's electrification rate, Olowosejeje proposes multiple-stage solutions. Firstly, he proposes putting in place a politically stable environment, ensuring access to reliable energy data that is readily available, and energy policies with policy actions supported by an enabling legislative and regulatory infrastructure.

Also, there is a need to increase access to development finance for energy solutions, exploring mechanisms that incentivise investment in alternative energy solutions (towards diversifying the continent's energy portfolio). Energy technology – towards developing technical aptitude – also needs to be disseminated.

"There is a need for community engagement (community-based participatory research) in determining best-fit solutions, as well as inculcating a community-wide energy technology sustenance culture," Olowosejeje said. "The first stage serves as the building blocks for the successful implementation of the second stage, with the final stage ensuring community-wide energy solutions sustenance post-implementation." GG

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Privatisation: the Nigerian experience

Nigeria's power supply is bedevilled by infrastructural decay, corruption, inefficiency and a lack of capacity

A real conundrum

Dianna Games

Nigeria, sub-Saharan Africa's largest economy in GDP terms, is one of the most underpowered countries in the world. With a population of nearly 200 million people, years of dysfunction in the power sector means that Nigeria has one of the lowest electricity per capita rates in the world at 150 kilowatts per hour. In the second-largest economy, South Africa, the per capita consumption is nearly 4,500 kw/h. Just 45% of Nigerians have access to grid power. It is estimated that 20 million households do not have access to reliable electricity.

A combination of infrastructural decay, corruption, inefficiency and a lack of capacity have undermined reform efforts over decades. It is estimated that the Nigerian economy loses $29.3bn annually due to its power deficit.

Vendors sell meat at the Oshodi night market in Lagos, Nigeria, lighting their stall with a fuel lamp in the absence of electricity
Photo: Pius Utomi Ekpei / AFP

Just over 4,000MW is available for distribution to the national grid, against installed capacity of 13,400MW. This is due to infrastructure challenges and supply constraints of gas, which provides 80% of power to the grid. The system also suffers from heavy technical and non-technical losses through the chain. By contrast, South Africa, despite having its own power woes, has installed capacity of just over 44,000MW for a third of the population.

In addition to gas, Nigeria's power comes from its large hydropower resources and generation from biomass and waste. Renewable energy is starting to attract private sector investment and is benefiting from the government's roll out of solar power to boost rural electrification efforts. National independent power projects also contribute power to the grid.

Most Nigerians still rely on fuel-powered generators which, collectively, provide eight times more power than the national grid.

But for now, the reality is that most Nigerians still rely on fuel-powered generators, which, collectively, provide eight times more power than the national grid. Nigerians spend an estimated $14bn a year to buy and run them, according to the country's Rural Electricity Agency (REA) and other experts, money that could be more usefully spent on clean energy options or paying for reliable grid power.

When the privatisation option was first put on the table in 2005, the national electricity provider, Nigeria Electric Power Authority (NEPA), was suffering from the effects of years of under investment. Its poor service had become the butt of jokes, with many saying the acronym stood for Never Expect Power Again.

In 2005, legislation was put in place to kick-start a privatisation process. NEPA was unbundled into 11 distribution companies (known as Discos) and six generation companies (Gencos), with the government retaining ownership of the transmission infrastructure, responsible for linking the generation companies to the distributors. The authority was renamed the Power Holding Company of Nigeria.

Political elites with international partners and local conglomerates were the main buyers of the assets, which raised about $2.5bn. The process, which was only completed in 2013, was expected to generate significant investment into the sector, end decades of debilitating power shortages and turbo-charge the economy. But the expectations were overly optimistic. Seven years later, the power system is still on life support.

It has become apparent that the privatisation model was flawed, says Precious Akanonu of energy think tank, Energy for Growth. A range of factors, including the non-payment of electricity bills by users (including

Labour unions in collaboration with civil society groups and students demonstrated in Lagos to protest against the 45% raise of electricity prices
Photo: Pius Utomi Ekpei / AFP

government institutions) and unrealistically low tariffs, made it impossible for the companies to recover costs and get a return on investment. The bidders, some with no experience of the sector, took a leap of faith, buying decrepit assets and entering a sector with embedded structural problems, including the vulnerability of the gas infrastructure to vandalism and attacks in Nigeria's oil and gas hub, the Niger Delta.

Akanonu says that the inability to recover costs meant the Gencos and Discos were unable to repay the $780m borrowed from Nigerian banks for the initial purchase, deterring the banks from providing further loans for investment into infrastructure improvements. The Discos have also battled to get consumers to pay, with collection rates only about 30% of debts owing. A culture of non-payment for services has developed over time as people battle with unreliable electricity, which has forced them to spend money on alternatives, mostly costly generators.

Millions of Nigerians do not have meters and are charged on estimated, rather than actual, electricity usage, which they say often bears no relation to how often they get power. To generate more power requires more investment, but investors are unlikely to invest in a business that is not paid for its services. It is a real conundrum.

The government set up the Nigerian Bulk Electricity Trading Company (NBET) in 2010 as a middleman between the Gencos and Discos in an attempt to get the system working optimally. NBET guaranteed it would buy power from the Gencos and supply the Discos, who would repay it from collections. But it has become a victim of the same culture of non-payment and its resources were quickly depleted. It, too, now owes the privatised companies millions of dollars, further threatening the viability of the system.

The transmission utility, which runs the national grid, is another sticking point. Retained by government in the privatisation process, it suffers from the same bureaucratic inefficiency and under-investment that once plagued the entire system.

So what to do? In 2020, the country's senate, among others, called for the privatisation process to be reversed, citing a lack of progress under the reform programme. But the calls have met resistance. The Association of Power Generation Companies says the government, which still owns 40% of the privatised assets, should rather address the deep-seated structural issues.

The Director General of the Bureau of Public Enterprises (BPE), Alex Okoh, says re-nationalising the power assets would be a serious mistake. "I think the Discos have become a topical and very emotive issue. We forgot that the electricity sector was almost dead before it was privatised. We must be extremely careful about these key national utilities." Fixing the problem, he says, requires analysing the entire value chain.

Power expert Sonny Iroche, a former executive with the transmission utility, says reversing the process would be a blow to Nigeria's reputation as a business destination. "The non-adherence to the sanctity of agreements is not wise. People have committed resources to this process because of the sanctity of agreements." He says the Covid-19 crisis gives Nigeria an opportunity to reposition the sector and let it realise its potential. "Nigerians aren't interested in who executes the services. They just want it done. We need to all join hands and look at the problems."

Nigeria, Iroche says, does not exist in a vacuum and it should be able to execute these functions optimally as countries do around the world. "There is no Nigerian way of doing things, there is only the proper way."

Writing on Nigerian website Stears Business, financial journalist Osato Guobadia says, "The worst-case scenario is that lenders who granted loans to the owners of the Gencos would liquidate their assets and sell the power plants to repay the loans taken. Realistically, given the strategic importance of the power plants, the government is highly unlikely to allow that to happen."

The best-case scenario is that the Discos can improve revenue collection. As the worst offenders are state-owned enterprises, Guobadia suggests the

government could take money from their annual budgets and pay it directly to the Discos to clear the debt. But, he says, there is unlikely to be political will for this.

There is a third way, he says. "The default scenario is that Nigerians could keep picking up the slack. We could keep granting loans to NBET to pay the Gencos and give newer ones to pay off existing debts. This would potentially evolve into a debt crisis, but at least it would keep our lights on. At least, for now."

Hopes are now pinned on the Presidential Power Initiative to address the problems. This is a deal with German energy giant Siemens to rehabilitate and expand the grid. It includes upgrading 105 power substations, constructing 70 new ones, distributing up to 35 new transformers as well as installing distribution lines.

The target is that 25,000MW of electricity by 2025 – a tall order, given the deep-seated challenges.

The government is also pushing for greater efficiency in the commercial uses of its enormous gas reserves.

Olabode Sowunmi, Senior Legislative Aide to the Senate President and founder of the Energy Hub, says the process is being driven by the Gas Master Plan. "This is essentially an aggregation of policies targeting investments and the development of infrastructure to support the investments."

While the grid is already powered by gas, the government wants to use the resource to build resilience in other parts of the economy. It has directed 9,000 filling stations to reconfigure their infrastructure to use gas, and the Association for Local Distributors of Gas has been established to drive downstream gas distribution to commercial and industrial end users.

The government is also fast-tracking the rollout of meters, offering a one-year waiver of import levies on equipment to bring down the costs for consumers.

It is also, under pressure from multilateral organisations, moving towards implementing cost-reflective tariffs in the sector and introduced a tariff hike in September 2020 towards this end. Part of the privatisation challenge has been the fact that tariffs have not reflected the real cost of power, which has effectively been subsidised for years.

The privatisation challenge has been the fact that tariffs have not reflected the real cost of power.

This has come at a bad time for Nigerians, suffering financial hardships resulting from the pandemic, but many believe it is also a good opportunity for Nigeria to "bite the bullet" and take the tough decisions needed to make the economy more resilient. GG

The Nile: stormy waters

The dispute between Egypt and Ethiopia over the Grand Renaissance Dam might just offer hidden opportunities

A powerhouse for regional integration

Anthony Turton

The Nile is the longest river in the world, but also the source of water for two great civilisations. Egypt is the epicentre of the oldest civilisation with a current population of 98 million people. It is dependent on the Nile for 97% of all water on exogenous flows – water originating outside its territorial borders – making it extremely vulnerable to upstream activities.

Ethiopia is home to the Orthodox Church in Africa, with a civilisation dating back at least 2,000 years, and a current population of 105 million. The Blue Nile is the largest contributor of water to the lower Nile on which Egypt is dependent, but its source is fully within the geographic limits of Ethiopia. At the heart of the issue are two massive dams, one in a desert where stored water is lost to evaporation and seepage, the other in the highlands where geology and topography provide storage with lower losses. Focusing only on the energy aspects of these two dams, both provide massive hydropower potential, but Ethiopia's Great Renaissance Dam can produce three times more energy than Egypt's Aswan High Dam can, in a more reliable manner.

In essence then, the conflict is about efficiencies of water storage and use versus national security fears arising from the inherent vulnerability associated with exogenous water.

At the heart of the dispute is the strategic importance of water, energy and food security. This is overlain by four critical issues – national security, energy needed for industrialisation, management of evaporative losses and tensions over the optimisation of system yield at national versus regional levels of control. To understand the dispute it's necessary to appreciate the way that each of these issues play out in the rhetoric and posturing of Egypt and Ethiopia as the two major actors.

In water constrained economies, all economic development is curtailed. This ultimately impacts on social stability, so it becomes a national security issue. This is certainly the case for Egypt, where national security concerns were triggered when French and British colonial rivalry saw an expeditionary force try to gain control of the headwaters of the Nile in 1898. This fear was made more apparent when the first Arab-Israeli War of 1948 saw the Egyptian Revolutionary Command Council, under Gamal Nasser, call for the "High Dam Covenant". The essence of this covenant is for Egypt to always have direct control of the Nile, most notably by storing more than double the annual flow of the river in the Aswan High Dam. So powerful was this covenant that any person questioning the impact of the dam was deemed to be unpatriotic and ostracised. The heart of the national security issue is strategic storage of water, which must be retained in Egyptian hands, irrespective of the implication. Stated differently, Egypt has chosen to achieve national security by retaining direct control of water, energy and food production within its sovereign sphere.

Egypt has chosen to achieve national security by direct control of water, energy and food production within its sphere.

Left: The Blue Nile Falls
Photo: CT Snow

Almost all countries choose to modernise their economies in response to the growing population. This is certainly the case for both Egypt and Ethiopia, with a combined population of 203 million. Early industrialisation in Egypt was opposed by Britain, who favoured cotton production to supply their own textile industry. This meant a trade-off when the Aswan High Dam was built, because water was needed for agriculture, which meant that releases were timed to suit agricultural production. This is at odds with energy production because the depth of the water determines the amount of energy that can be generated.

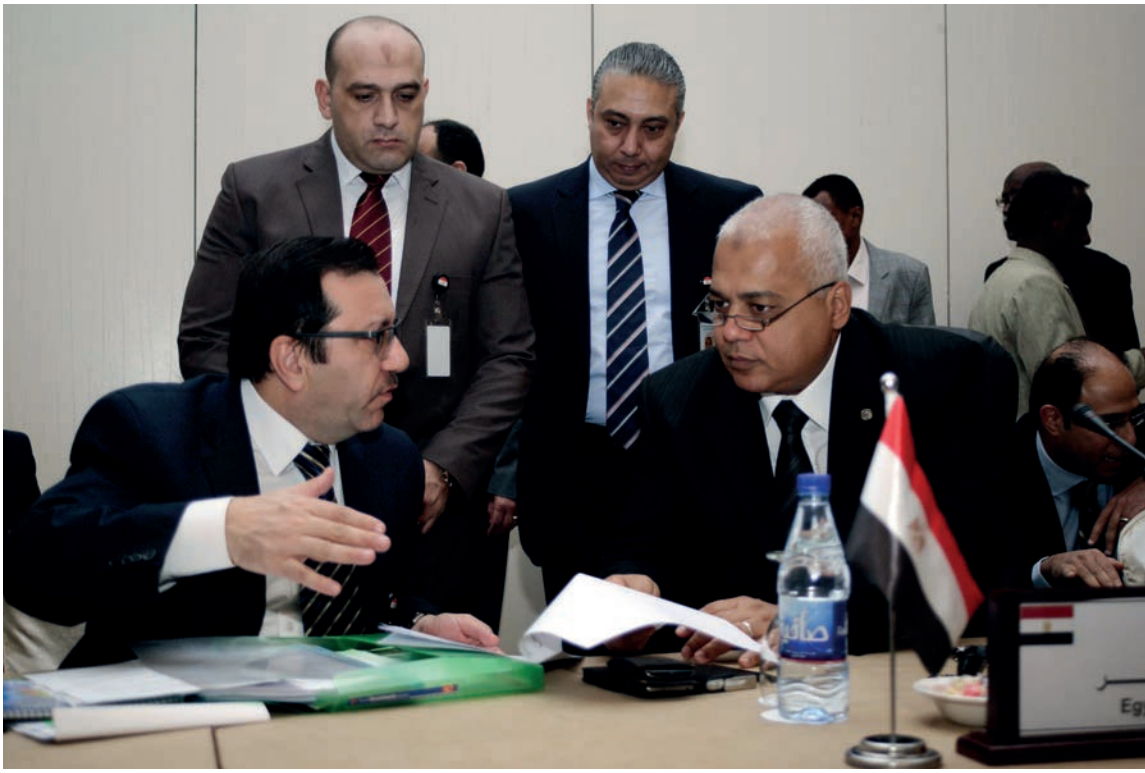
So, while Egypt has an installed capacity of 2,100MW of power, this is only achievable if water is not released for crop production. This is not the case for Ethiopia, which has 6,450MW of installed capacity that is not constrained by the intermittent need to release water for irrigation. This brings into focus the strategic issue of water, energy and food security, by opening up the potential benefit of optimising the system at a level above that of the independent sovereign state.

The energy needed to create an industrial economy is not compatible with the water storage needs for agricultural production.

Stated differently, the energy needed to create an industrial economy is not compatible with the water storage needs for purely agricultural production, so Egypt has a stark choice. If it wishes to retain sovereign control over water and food security, then it cannot generate enough energy to diversify its economy. Ethiopia, on the other hand, can generate energy for export to other countries in the region, thereby diversifying its economy and creating food security through importation rather than domestic production.

There are two universal and inescapable realities for all dams in arid climates. The first is that the larger the surface area of the dam, the greater the losses of water to evaporation. The second is that the surface area of the dam, expressed as a function of total volume stored, means that a deep dam built in a steep-sided valley at elevation, will always have lower evaporative losses when compared to a shallower dam built across a wider floodplain. This is a critical issue, because the more a river is dammed in a desert, the greater becomes the loss to evaporation, and the lower the yield of the system for economic activity.

Which brings us to the essence of the dispute between Egypt and Ethiopia. It is not a dispute over the environmental impact of hydro-powered energy, because baseload energy requires a steady flow of water through the turbines, with limited fluctuation to account for peak demand. Rather it is a dispute arising from the clash between water, energy and food security at national



Egyptian Water Minister Mohamed Abdul Muttalib listens to a member of his delegation during tripartite talks about Ethiopia's Grand Renaissance Dam in January 2014 in the Sudanese capital, Khartoum
Photo: Ebrahim Hamid / AFP

level versus regional level. Egypt can still get its water from the Blue Nile, once the Grand Renaissance Dam has been filled, so the issue is the rate of filling, and not the energy production. More importantly, Egypt will be guaranteed a baseflow down the Blue Nile, which currently contributes about 2/3 of the total flow, simply because Ethiopia will be unable to close the sluices once the energy is flowing into a regional grid. The argument that Ethiopia can shut down the flow is illogical, because that would undermine the very objective of the Grand Renaissance Dam, which is to generate energy for export to the region.

To reframe the debate, the obstacle to be overcome is the assurance that Egypt would receive greater benefits by relinquishing control over strategic storage to a location upstream in the basin. To find an answer to this national security problem, we need look to the Lesotho Highlands Water Scheme. Built during apartheid, South African national security elites were fearful that Lesotho could shut down supply of water to the Witwatersrand goldfields and the cities of Johannesburg and Pretoria. This was overcome by clever engineering and design, because the Muela hydropower plant was located

downstream of the Katse Dam, but upstream of the point of delivery of water into South Africa at Liebenbergsvlei. The whole idea was that if Lesotho chose to shut down the delivery of water, then their own energy supply would fail. This was a form of mutually assured destruction, a security concept central to nuclear deterrence.

The dispute between Egypt and Ethiopia over the Grand Renaissance Dam offers a unique opportunity to reframe the water, energy and food security dilemma facing governments with growing populations in an arid environment. While it is desirable to create security in all three realms by monopolising control at national level, the harsh reality is that this is simply not possible. Countries are locked into relationships with other sovereign states by virtue of their shared dependence on a river. The Nile locks in 11 countries, some the poorest in Africa, and the flow of the river is such that by sharing water in any way that meets the needs of the downstream riparians – Egypt and Sudan – then food and energy security cannot also be guaranteed for other states.

Water sharing is a recipe for long-term conflict, because there is not enough in the river, and the zero-sum nature of the allocation implies a growing conflict potential. A viable alternative has to be considered, and this is best framed in a benefit-sharing framework. Realistically, water can be used more than once in each system, so a plus-sum outcome is possible. The generation of electricity in the headwaters does not reduce the stock of water available for downstream use.

This implies the need to cooperate at multilateral level, to negotiate international agreements that are legally enforceable, and even guaranteed by external agencies as required. Such an agreement would determine the rate at which the Ethiopian dam can be filled, as well as the minimum and maximum discharges needed to satisfy the legitimate security concerns that

A satellite image showing a view of northwestern Ethiopia that focuses on the status of the Grand Ethiopian Renaissance Dam (GERD) and the Blue Nile River in July 2020
Photo: AFP / Maxar Technologies 2020

Egypt has. In effect then, water, energy and food security would be shifted from national level to a regional level, managed within the context of a River Basin Authority representing all riparian states. Water and food security for Egypt would be offset against the creation of energy security in Ethiopia, acting as the powerhouse for regional integration and the sustained creation of an emerging industrial economy that benefits all riparian states. GG

Indoor pollution: a silent killer

Africa's rural poor are particularly reliant on biomass for cooking and heating, exposing them to high levels of pollutants

The high cost of slaving over a hot stove

Barnabas Thondhlana

As COVID-19 wreaks havoc across continents, an unfashionable killer silently and stealthily chokes the life out of thousands of poverty-stricken women and children in Africa and south-east Asia.

The World Health Organization (WHO) estimates that in sub-Saharan Africa alone, 600,000 people lose their lives every year from indoor air pollution. Beyond these staggering numbers are the faces of women and children who bear the burden of indoor air pollution cooking and lighting.

Indoor air pollution is the norm where firewood and charcoal remain a popular choice of fuel amongst households. The UN Environment Programme estimates that wood fuel and charcoal alone account for 40% of energy use in Africa. These glaring statistics have contributed to a mushrooming of enterprises and job creation but also deforestation and a health hazard that is an invisible killer among populations.

The UN Enivonment Programme estimates that wood fuel and charcoal alone account for 40% of energy use in Africa.

In fact, according to a May 2019 report by international development aid agency Hivos, cooking with charcoal and firewood sources still accounts for four million premature deaths a year, puts significant strain on already stressed forest resources, and it is the single largest source of greenhouse gas emissions (GHGs).

Africa's energy poverty index, now at 620 million people with no access to electricity, according to the International Renewable Energy Agency (IREA), is a social and economic tragedy inhibiting development. In Kenya, an over-reliance on biomass led to environment legislation in 2018 placing heavy restrictions on cutting down trees and charcoal production but which, unfortunately, has had little effect on reducing indoor pollution.

The United Nations Environment Programe (UNEP)'s George Mwaniki says indoor air pollution causes an estimated 4,000 premature deaths every year in Zimbabwe alone. "Wood is the main fuel used

Beneficiaries of a World Wildlife Fund pilot project to produce domestic biogas to combat illegal charcoal production with a new gas cooker in their home in Sake, DRC, 2019
Photo: Alexis Huguet

for cooking and heating and accounts for 64% of the energy mix in Zimbabwe," Mwaniki says. "In rural Zimbabwe, 80-90% of people are heavily dependent on wood fuel, and they light their homes with kerosene."

WHO says the majority of households using solid fuels burn them in open fires or simple stoves that release most of the smoke into the home.

Leah Lunga has few options when it comes to preparing meals. "We use charcoal for cooking as there are now no trees for wood in our area," Lunga, who lives with her daughter-in-law and three grandchildren, said from her one-roomed house in Epworth, some 25 km east of the capital, Harare "We buy our charcoal from traders who import it from Zambia, as it burns longer but has more smoke. I already suffer from breathing problems, but I am sure I will survive."

As observed by Curtin University professors Krassi Rumchev and Jeff Spickett *et al* in a study titled 'Indoor air pollution from biomass combustion and respiratory symptoms of women and children in a Zimbabwean village', published in 2007, the rural areas of developing countries are particularly reliant on biomass for cooking and heating, exposing them to high levels of pollutants associated with a range of respiratory symptoms. Exposure to this pollution heightens the risk of childhood pneumonia and contributes to lung cancer, strokes, heart disease and pulmonary ailments.

'Clean', more fuel efficient cookstoves have been identified as one of the four key domains for global investment.

The study investigated domestic exposure to carbon monoxide (CO) and respirable particles (RSPs) in association with respiratory symptoms among women and children in 48 households. It found that indoor levels of CO and RSPs exceeded WHO air quality guidelines in more than 95% of kitchens. Almost all of the women 94% – had respiratory symptoms, while the figure was 77% for children.

"Clean", more fuel efficient cookstoves have been identified as one of the four key domains for global investment, with a particularly strong potential to transform the lives of girls and women. Girls and young women who cook over fuel-efficient stoves will spend less time gathering fuel and cooking food, which gives them more time to pursue educational and work opportunities. Other direct benefits of switching to fuel efficient cookstoves include safety; girls and women are less exposed to the risk of physical and sexual violence when forced to scavenge for firewood.

A collaboration between UNICEF and GOAL – an international humanitarian response agency established in Ireland more than 40 years ago,

which supports Zimbabwe's rural poor – has piloted the use of fuel efficient cookstoves as a cleaner and environmentally friendlier method of cooking. More fuel efficient stoves are not only healthier than open wood fires they also mean women spend less time collecting firewood and cooking. To date, UNICEF says it has reached more than 3,000 households with this programme.

However a 2016 Hivos/World Future Council points out that while more efficient stoves remain an important interim solution that has delivered impressive results in certain countries, they are not a long-term or truly sustainable solution to the challenge of cooking. As an alternative, clean cooking technologies have to be "environmentally, socially, as well as economically sustainable to be considered truly sustainable in the long-term".

One alternative, biogas – the process of producing energy by fermenting waste – is gaining in popularity around the world as a way of reducing reliance on fossil fuels, cutting deforestation and providing cheap, reliable and easy-to-produce local energy. It has proved an attractive alternative in rural areas,

Wood from the last forests in southwestern Niger are loaded up, 2007. The Sahara has already claimed two-thirds of Niger and keeps advancing
Photo: Boureima Hama / AFP

beyond national power grids, where animal dung is plentiful, but firewood is becoming harder to access.

Despite the benefits, a $3 million project to roll out biogas across Zimbabwe, set up by the government in partnership with development organisations SNV and Hivos International, has had a low take-up in most rural areas. Over the past five years, about 40 digesters have been built at farms and institutions and some 250 home units – well short of the project's aim of 7,400 home digesters by 2020.

The generation of biogas reduces soil and groundwater pollution as it diverts waste from landfills.

"Biogas is cleaner energy compared to charcoal," says Wimbiso Simbi, an environmental specialist with the Southern African Research and Development Centre.

"The generation of biogas reduces soil and groundwater pollution as it diverts waste from landfill and leads to improvements in the environment, sanitation, and hygiene."

On the wider continent, the Africa Biogas Partnership Programme (ABPP), launched in 2009, initially had a target of giving more than 500,000 people access to clean biogas energy. Implemented by Hivos East Africa and SNV, ABPP's story has been simple; building a commercially viable market for the upscale and adoption of biogas in countries that have been most affected by climate change.

In response to emailed questions on the status of the programme, the ABPP's director, Wim van Nes, said: "ABBP was terminated by the end of March 2020. [But] a total of 72,354 household digesters have been installed under this programme, providing access to biogas (clean energy) and bio-slurry (potent organic fertiliser) to about 362,000 people."

The stories from this initiative have been encouraging: Burkina Faso's government is leading an alliance in West Africa to have countries in the Sahel region adopt biogas for clean cooking; in Uganda, Tanzania and Ethiopia, bio-slurry has been commercialised as a significant component of organic farming, while Kenya has become a leader in providing an enabling environment where the private sector can partner with government to uphold quality standards in the maintenance of biogas plants within households.

While it is difficult to change existing behaviours, and clean stoves are often abandoned in favour of traditional methods, there is now growing support for clean cookstove projects that have the potential to help save hundreds of thousands of lives. GG

China is investing heavily in coal-fired plants in Africa, even as it prioritises renewables at home

China's billion dollar dirty coal projects

Andrew Mambondiyani

As China pushes clean energy policies at home, it is exporting high-polluting coal fired thermal power plants to many countries in Africa which have been struggling with drawn-out energy crises.

With American, Japanese, and European investors – and the African Development Bank – shunning coal projects, Chinese banks and companies have seized the opportunity to bankroll various coal-fired thermal projects in Africa.

In 2016, Endcoal – an environmental, social justice and health advocate organisation – revealed that most of the

coal-fired thermal plants financed by the Chinese were in Ghana, Kenya, Malawi and Zimbabwe. And in these countries, China financing was associated with 73 to 100% of coal-fired thermal proposals.

At the same time, China was backing half the proposed coal capacity in Egypt, Tanzania and Zambia, with state-owned Export-Import Bank of China, the China Development Bank and the Industrial and Commercial Bank of China the main financiers, Endcoal added.

Ironically, back home, the Chinese government is ramping up investments in renewable energy.

Ironically, back home, the Chinese government is ramping up investments in renewable energy to counter the country's air and water pollution, according to the Center for Strategic and International Studies. And Lauri Myllyvirta, lead analyst for the Centre for Energy Research and Clean Air – an independent research body – told Bloomberg that "China has enormous state-owned thermal-power manufacturing and engineering firms".

Amid serious and persistent electricity crises, Zimbabwe is one of the African countries that has fully embraced investments worth billions of dollars in coal-fired thermal power plants from Chinese investors.

Currently, a US$1.3 billion project to expand Hwange thermal power station in Zimbabwe, funded by the Export-Import Bank of China through Sinohydro, is under construction. Simultaneously, China has agreed to fund a new US$4.2 billion giant coal-fired thermal project at Sengwa in the country.

Hwange has a 920MW installed capacity, but upon completion the expansion project will increase power generation to 1,200MW, while the new coal-fired thermal plant at Sengwa will add at least 2,000 megawatts to the country's national power grid.

In early 2020, Caleb Dengu, chairman of RioZim Energy – the company behind Sengwa – was bullish about the success of the project.

"This is testimony of Chinese commitment to development projects in Africa. The Chinese are interested in joining hands. The Chinese are looking at the business opportunity. We bring the market knowledge and management capacity, they bring the finance and the technology," Dengu was quoted in the media as saying.

On its website, RioZim reveals that the Sengwa power plant project is based on a coal resource of 1.3 billion tonnes, capable of generating up to 2,000MW of power, almost as much as Zimbabwe's current total installed capacity. "The proposed project envisages the construction of a number of smaller power plants over the next 10 years. In order to achieve this goal, [the company] is in the process of bringing in technical partners to help construct the power station," the company says.

However, climate experts and activists have been outraged by the billions of dollars poured into coal-fired thermal plants in Zimbabwe when, globally, many countries are shifting to clean and sustainable sources of energy.

Landry Ninteretse, the Africa managing director for 350.org – a non-

governmental organisation pushing for a safe climate and a better future – told *Africa in Fact* that the international scientific community is telling countries that the world cannot absorb any new fossil fuel developments if humanity is to tackle the climate crisis.

And the Zimbabwean government's plans to construct yet another coal plant, Ninteretse says, is not in line with the country's commitments under the 2015 Paris Agreement, which came into effect in 2016, whereby most of the world's countries agreed to address the negative impacts of climate change

"While countries worldwide are shutting down coal plants, why should Zimbabwe accept a dirty source of energy which is the biggest single cause of air pollution with devastating environmental impacts?" queries Ninteretse, who describes the proposed Sengwa coal power plant as an untimely development.

"As 350.org, we would like to ask the Zimbabwean government to take action to avert the climate crisis as well as guarantee the health of its people by focusing on solutions that eliminate fossil fuels associated with air and water pollution and transition to clean and sustainable energy," he says.

Melania Chiponda, a Zimbabwean climate change and women's rights activist, says there is absolutely no logic behind investing in coal power plants in Zimbabwe given how the country is disproportionately affected by the effects of climate change; all of which have resulted in the loss of lives and devastated communities and the economy of the country.

"While the memories of the climate change-induced cyclone Idai (in March 2019), which left 340 people confirmed dead and hundreds missing, leaving a trail of destruction, which rendered more than 51,000 people homeless and affecting a total of 270,000 people are still fresh in people minds, we are surprised that the government still wants to build new [coal-fired thermal] plants using the same technologies," says Chiponda.

Chiponda adds that Zimbabwe should instead embrace new energy technology innovations, which are accessible and affordable and known to not only provide reliable energy but are also able to generate new job opportunities.

However, Zimbabwean economist Victor Bhoroma told *Africa in Fact* that there are both pros and cons to investing in a thermal powered plant just as there are with any other large-scale investment in energy production worldwide. And, he says, there are a lot of factors to consider when looking at such investments.

Bhoroma points out that Zimbabwe is well-endowed with coal reserves, which he believes can be exploited for thermal electricity production at lower costs than other modes of electricity generation such as wind, solar, hydro and nuclear.

There are both pros and cons to investing in a thermal powered plant, just as there are with any large-scale investment.

"Coal-fired thermal electricity generation costs are extremely low; this means Zimbabwe is utilising an abundant resource in coal to generate

electricity at low costs. Initial cost is relatively low and the repayment period for such an investment is therefore shorter," says Bhoroma.

He says the expansion of the Hwange thermal power station will see a reduction in the country's electricity imports, which topped $200 million in 2018.

"Even if there are other methods of electricity generation, what the government is doing is to maximise the utility of the already installed plants to reduce our dependency on electricity imports," he says.

Soda, told the Zimbabwe state-owned newspaper – *The Sunday Mail* – in September 2020 that overall, power generated from the hydrocarbon and coal activities presently underway will cumulatively inject more than 3,000MW into the grid.

But, Soda says, additional electricity contributions are expected from renewable energy projects such as solar, some of which are already underway. GG

Although other forms of clean energy are being considered, their feed into the national grid may not meet current demand.

Bhoroma says that although other forms of clean energy such as solar and geo-thermal are being considered in other parts of the country, their completion may be long-term and their feed into the national grid may not meet current demand.

He does agree, however, that on the downside coal-fired thermal power plants result in massive pollution from coal mining itself, with air pollution rife in mining sites.

Though repeated efforts by *Africa in Fact* to get the Zimbabwe Energy Regulatory Authority's position on coal-fired thermal plants were unsuccessful, the country's energy minister, Zhemu

Right: The barrage of the Inga 3 dam
Photo: Alaindg

Inga 3: does it make sense?

As the third phase of DRC's Inga 3 hydropower project falters, questions have been raised about the financial risk to both host and its main client, South Africa

Wind and solar change the game

Grace Wu and Ranjit Deshmukh

Seven years ago, Democratic Republic of Congo (DRC) proposed the Inga 3 hydropower project with great fanfare. Third in a series of dams that would form the Grand Inga complex on the Congo river, the project has been touted as a solution to southern Africa's energy deficit woes and a way for DRC to participate in regional economic development.

According to South Africa's most recent Integrated Resource Plan (IRP 2019), the country plans to import 2.5 GW of electric power from Inga 3 (or more than half of the original 4.8 GW design capacity), a commitment reiterated in 2020 by South African President Cyril Ramaphosa. The largest remaining fractions of Inga 3's electricity generation that will remain in the DRC would be purchased by the mining industry. Although 90% of the population in DRC lack electricity access, less than 10% of the electricity from Inga 3 is expected to supply residential electricity needs. According to a 2014 estimate from the World Bank, the project would cost $14 billion, which is almost a third of DRC's gross domestic product (GDP).

Seven years later, development of Inga 3 has failed to begin as the project continues to be stymied by conflicts. In 2018, based on a proposal from a Chinese-European consortium, DRC considered more than doubling Inga 3's capacity from 4,800MW to 11,000MW, potentially threatening to plunge DRC into even greater debt. Earlier in 2020, one of the Spanish companies pulled out of the consortium in the lead for developing Inga 3. Despite these conflicts, DRC President Félix Tshisekedi and regional leaders continue to push to revive plans to develop the dam.

Does Inga 3 make sense? In our research paper, we concluded that pursuing large hydropower dams in DRC is financially risky for South Africa. We assessed the feasibility and cost-effectiveness of renewable energy alternatives to Inga 3 to serve the energy needs of both the host country, DRC, and the main energy buyer, South Africa.

A Congolese policeman watches over dam 1 at the production site of the Inga hydroelectric dam on the Congo river, 2013
Photo: Marc Jourdier /AFP

The hydropower potential at the Grand Inga site on the Congo River, the largest remaining untapped hydropower potential in the world, has drawn the interest and attention of development banks and regional governments for the past several decades. However, in just the past five years, the cost of alternate energy sources like wind and solar has changed the game for cost-competitive and sustainable energy generation that can be rapidly scaled up. These renewable energy sources can address severe energy deficits quickly and cost-efficiently. Evidence shows that wind projects take only one to three years to build and most solar photovoltaics (PV) projects take a year, incurring lower costs than similar-sized hydropower projects that take five to 10 years to build. In fact, the latest construction time estimates for Inga 3 is eight years. Longer build times lead to greater costs due to interest on capital. Further, analysis of constructed large hydropower dams showed that these projects cost twice the amount they quoted before the start of the project. We found that even without considering the large environmental and social impacts, the dam is an unsound investment based on plain economics.

In our study, we first assessed the most cost-optimal electricity generation investments for South Africa, the largest potential buyer of Inga 3 electricity. Our approach directly considered the economics and energy generation potential of the proposed 4,800 MW Inga 3 project as well as the temporal variability of potential wind and solar projects across South Africa.

We found that a mix of wind, solar PV, and some natural gas was on the whole more cost-effective than Inga 3 to meet South Africa's future demand. This conclusion accounts for the impact of several uncertain factors that could change overall costs. These factors included Inga 3's annual electricity generation, Inga 3 cost overruns, the performance of potential wind and solar projects in South Africa, and the demand for electricity in the future.

Less than 10% of sensitivity scenarios found that importing Inga 3 electricity would be more cost-effective.

Less than 10% of sensitivity scenarios examined found that importing Inga 3 electricity would be more cost effective. The only scenarios in which Inga 3 was more cost-effective were those that assumed significantly lower than average wind energy performance. When we included either transmission costs from DRC to South Africa or 20% cost overruns, none of the scenarios favoured Inga 3. One estimate puts the cost of the transmission line alone at more than $1 billion, in addition to the $14 billion for the dam itself, as estimated by the World Bank.

In the second part of the study examining DRC's energy needs, we found

that potential wind and solar generated electricity within the country could be cheaper than the World Bank-estimated price of electricity from Inga 3 for both retail customers in Kinshasa and mining customers in Katanga province. Further, these renewable energy technologies are suitable for providing decentralised and off-grid access to electricity to DRC's geographically dispersed population.

The proposal to more than double the initial capacity of 4,800 MW examined in our study to 11,000 MW would clearly change the economics described here. However, President Tshisekedi has expressed preference for the original smaller 4,800MW proposal. If the design changes, it will be nonetheless critical to perform a similar economic assessment for the latest Inga 3 proposal. This is particularly important as the project's cost-benefit analysis and alternatives grow in complexity with more neighbouring countries like Angola beginning to express interest in importing Inga 3 electricity.

A regional study is needed to examine alternative energy sources that could also be internationally traded within the Southern Africa Power Pool, particularly in light of likely climate change impacts on hydropower production in the Congo and neighbouring watersheds. The international and DRC communities concerned about the energy security, financial stability, social equity, and ecological viability of DRC and the Congo River Basin must recognise and fill this important knowledge gap.

Of course, economics should be only one of many factors to weigh when choosing energy technologies. Like many other mega hydropower projects, Inga 3 has been fraught with potential severe social and environmental impacts. At least 35,000 people would be displaced by Inga 3 alone. The potential ecosystem impacts include the decline of fisheries upstream of the dam, threats to freshwater diversity and mangroves in the Congo delta, and reduced carbon sequestration through reduced organic sediment transport downstream to the ocean.

The Inga 3 project is seen by many as a panacea for solving DRC's and the southern African region's energy problems. But investing in such a large project that could cost as much as a third or more of DRC's GDP has significant risk. While it is clear that Inga 3 does not make a sound economic investment for South Africa, for DRC the alternatives are to invest in wind, solar and increasingly cost-effective storage solutions. The DRC government and international financial institutions like African Development Bank (AfDB) backing Inga 3 can still change course to choose these more sustainable and lower-risk avenues to provide cost-effective access to energy and spur economic development. GG

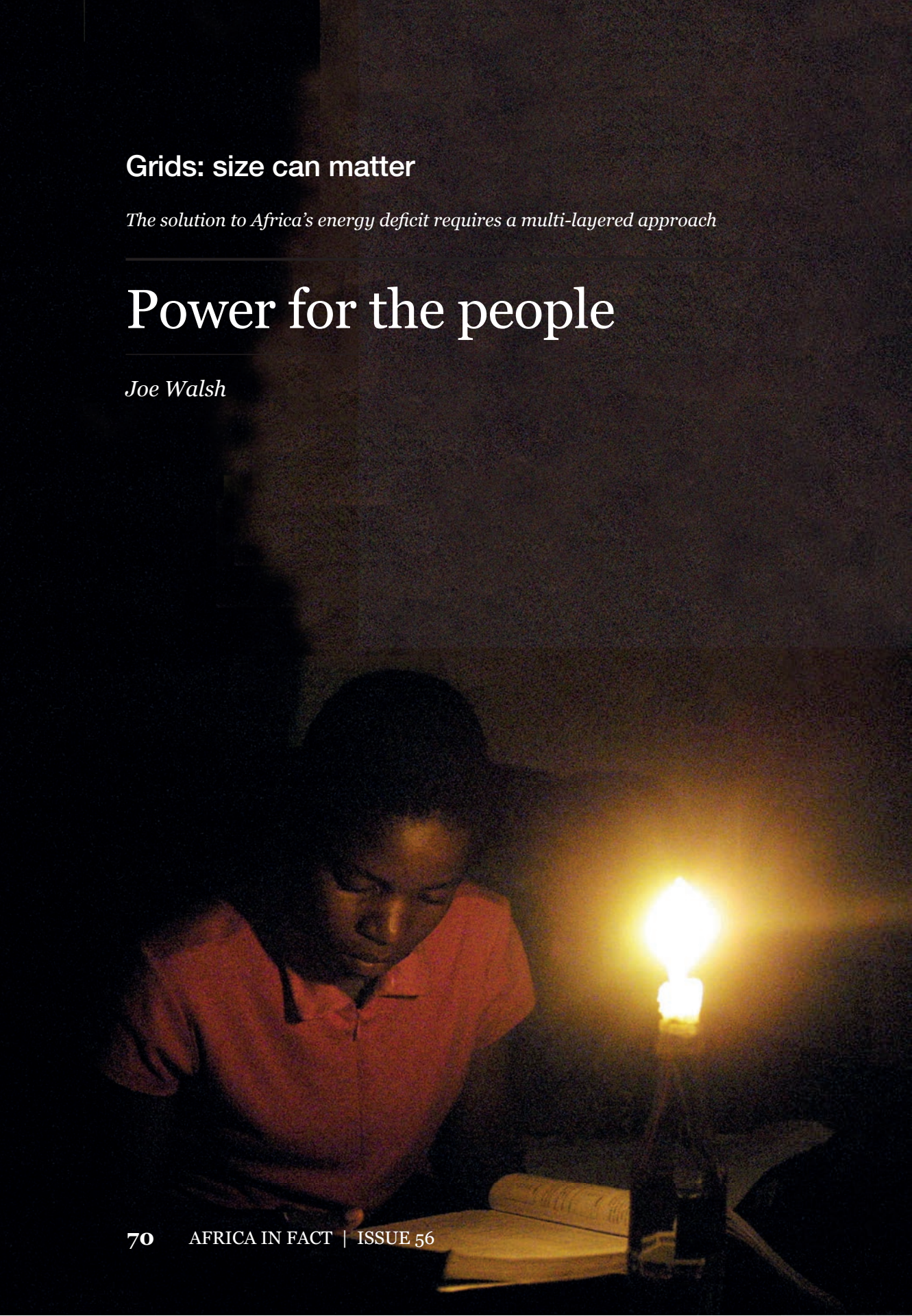
A version of this article appeared in *The Conversation*.

Grids: size can matter

The solution to Africa's energy deficit requires a multi-layered approach

Power for the people

Joe Walsh



Africa faces a gigantic energy challenge. Latest estimates are that on the continent 600 million people, virtually all residing in sub-Saharan Africa and amounting to more than half the population, still don't have access to electricity. Added to this, Africa has the youngest and fastest growing population on the planet, which is expected to double to 2.5 billion people by 2050. The International Energy Agency (IEA) expects energy demand to grow by 60% by 2040, in a situation where already the vast majority of people are either not served or underserved with electricity, with power cuts across the continent having a hugely detrimental economic impact.

Traditionally, the answer to this energy problem has been to build big energy infrastructure projects, grow the generation capacity of national grids and connect more people to the national grid. Large infrastructure projects, such as the Grand Inga Dam Hydroelectric project in Democratic Republic of Congo (DRC), which has the potential to provide 40,000MW of hydropower to the continent – approximately 40% of its current electricity needs, initially appear to be the solution. Get enough funding into this and other similar projects, grow the grid to reach every single person in Africa and the energy crisis is solved.

However, the project has almost come to epitomise the problems of relying on mega-infrastructure projects to supply power to those without it across Africa. It is beset with problems that have dragged on for decades. The project consists of six phases, at a conservative estimated cost of $80 billion, the first was completed in 1972, the second in 1982 with the third expected in 2028. It currently provides just 1,775MW of power.

Though the Inga Dam's scale is unparalleled, the types of problems it has encountered and continues to do so are not unique. Financial, political and logistical problems have all beset the project, with various partners dropping out, questions over transparency and accountability as well as legal and parliamentary challenges causing never-ending delays and increasing costs.

"The reality is that sub-Saharan Africa won't follow the same electrification path we've seen in other parts of the world," summarised David Riposo, energy access advisor at Power Africa, the US government-led partnership with the goal of adding more than 30,000MW of new electricity generation capacity and 60 million new electricity connections for homes and businesses by 2030. "Much of the continent still consists of rural villages located far from major roads, making traditional grid extension to these communities uneconomical in the short-term."

However, there would appear to be a solution: decentralised renewable energy (DREs) consisting of mini grids that would be off the main national

Left: Zimbabwean Kudakwashe Sithole, 16, does her homework by candlelight in March 2006 following a power cut in her Harare suburb
Photo: STR /AFP


KONECRANES
20t

grid and powered by small-scale electricity generation, typically less than 15MW, to supply power to a limited number of customers. These also have the benefit of being able to offer clean and affordable renewable energy rather than from burning fossil fuels or using kerosene, which is a comparatively costly fuel source yet so often used in large areas of the continent where electricity is sparse.

"DREs are cheaper, faster, and easier to deploy in rural and remote areas that are untenable for grid electrification or may not be connected by the grid in the near term. African Development Bank (AfDB) is committed to dramatically expanding its investments in and financing for decentralised renewables," says Daniel Schroth, acting director for Renewable Energy and Energy Efficiency at the bank. "We see immense potential for expanding finance for micro/mini-grids in Africa."

As does the IEA which, in its 2019 Africa Energy Outlook report, suggested grid-based electrification is the least-cost option for 45% of the continent's population. This leaves the majority, 55%, to come from off-grid and mini-grid connections.

Solar panels at the new 15 MWp photovoltaic power plant supplying the Canadian mining company Iamgold's Essakane gold mine, near Dori in northern Burkina Faso
Photo: Ahmed Ouoba /AFP

Despite this, large infrastructure projects do experience further problems. On top of being expensive, running into serious delays, ballooning costs and failing to reach those living off the grid there can also be difficulties in getting them online and connected to a country's electrical grid system in the first place.

For instance, Nigeria currently has a generation capacity of 12,522MW, but it has a theoretical transmission capacity of only 7,500MW, meaning it is unable to distribute across its grid the electricity generated if all its power stations are running correctly. Though, due to recurrent problems around maintenance, trips, faults and leakages that make many of the power stations unable to supply the grid, the country's average operational capacity is approximately 3,879MW, with a peak of 5,244MW, which was achieved last year. A lack of maintenance, along with a lack of investment in the transmission capacity side of grid infrastructure, has resulted in a transmission network that cannot provide for the energy needs of the country.

Nigeria's electricity demand is estimated to be four to 12 times what the grid is currently supplying.

As the continent's biggest economy with a large and growing population, Nigeria's energy needs are severe. Currently, the country's electricity demand is estimated to be four to 12 times what the grid is currently supplying, and that need is only going to grow.

One example of this problem with transmission capacity not matching generational capacity was the Lake Turkana Wind Power (LTWP) project in northern Kenya. LTWP was a 310MW project, which cost $680 million and was financed as a public-private partnership (PPP), securing debt investment from a syndicate of banks led by the AfDB, although the World Bank declined to invest, citing concerns over the power purchase agreement with the Kenyan government.

As Africa's largest wind project that would increase Kenya's power generation capacity by roughly 17%, as well as save the equivalent of up to 736,615 tonnes of carbon dioxide being released into the atmosphere each year. it appeared to be an ideal energy project for Africa. From initial discussions in 2005, the whole project was built and ready to begin transmission in 12 years. In addition, the project used an innovative financial structure and pulled in private capital from institutional investors, with funding guarantees by the AfDB and European Investment Bank (EIB). It also had capital from the EU-Africa Infrastructure Trust Fund (EU-AITF), a financial instrument, which blends development finance institution monies with grant monies from the European Commission, to fill the equity gap.

However, once it was ready, the transmission line to connect it to the grid had not been completed. The construction of the 435 km transmission line had run into several problems with the contracted company experiencing financial difficulties and work needing to be redone. This led to a 15-month delay and resulted in the Kenyan government having to pay $52.5 million to LTWP in fines from lost revenue, which was ultimately paid by the Kenyan taxpayer who were unable to access the electricity from the project.

Despite this incident, the AfDB remains committed to large infrastructure projects in potentially unconnected areas as these were all potential problems that were considered before LTWP started as a project.

"AfDB is supporting interconnections, development of regional power markets and strengthening of transmission and distribution networks; all with a view to giving countries access to large competitive power markets and meeting energy security needs in a cost-effective manner," explains Schroth.

However, "AfDB's interest in decentralised solutions (including micro-grids) is not so much a reaction to challenges seen within the utility-scale landscape – because we need to address these as well," he adds.

Yet mini grids have their own problems, most notably scale and financing. "Financing continues to be a challenge for the off-grid sector in sub-Saharan Africa," explains Power Africa's Riposo. "Revenue risk exceeds the tolerances of many lenders, and the capex is too small for conventional project finance."

Schroth agreed, adding: "There is still a lack of pure commercial financing as the mini-grid market lacks scale, and developers' project track records are limited."

Mini/microgrids are not and should be not seen as a competitor to the utility-scale projects, but as a complement.

Organisations like Power Africa and the AfDB are both looking to support mechanisms, such as the Sustainable Energy Fund for Africa (SEFA) and Beyond the Grid Fund for Africa that look to address this funding issue and galvanise investment into mini grids with innovative blended finance facilities.

"Mini/microgrids are not and should not be seen as a competitor to the utility-scale projects but as a complement," Schroth concludes. "The choice of one or the other, or both in different geographies depends on the desired tier of access, their economic viability, and the new opportunities brought by technological progress." GG

Tanzania: damn the environment

The Stiegler's Gorge project is a 48-year-old folly that will not deliver the energy security that President John Magufuli seems convinced it will

A very expensive white elephant

Ross Harvey

Stiegler's Gorge, Nyerere National Park, Tanzania
Photo: Ross Harvey

Every aspirant dictator seems to want at least one Soviet-style mega-project to their name. It is almost as if the construction of a white elephant will validate the personality cult that they invariably build for themselves. The Stiegler's Gorge hydropower project in Tanzania is President John Magufuli's version, a project first conceived in 1972 and never implemented for reasons that I hope to make obvious in this piece. Colloquially known as "the bulldozer", Magufuli has indicated that any vocalised objection to the project will land the objector in prison.

When I first travelled to Tanzania in early 2016, the nation was euphoric about Magufuli having come to power, despite serious problems with the previous year's elections. His ruling party, the Chama Cha Mapinduzi (CCM) lost the Zanzibar element of the 2015 elections but then won the 2016 re-run. The party has been in power for 59 years now. At the time of writing, the 2020

elections were scheduled for 28 October and the opposition had little to no chance of winning, largely because it's extremely risky to be an opposition politician and it's pretty much illegal to gather followers in any public way.

Magufuli won the (mainland) 2015 elections on an anti-corruption ticket. In a nation racked by a history of extensive grand corruption, he represented a welcome reprieve. By 2014, Tanzania scored a dismal 31 (out of 100) on Transparency International's Corruption Perception Index. Since coming to power, Magufuli has improved that score to 37. However, it is one thing to move the needle on petty corruption; it's another entirely to put an end to grand corruption. There's only so far that he can go before he clashes with his own loyalists within the CCM. In a *de facto* one-party state, internal divisions matter more than the official opposition for power retention calculus.

Magufuli is bulldozing ahead with the Stiegler's Gorge hydropower project in a way that suppresses information and transparency.

Corruption is not only about embezzling money; sometimes it's about making decisions that are corrupted by illusions of grandeur. Magufuli is bulldozing ahead on the Stiegler's Gorge hydropower project in a way that actively suppresses information and transparency. I visited the site in 2017 and witnessed the remains at past attempts to build this dam – a physical expression of the lack of wisdom at attempting such a project. The gorge is spectacular; it sits in the heart of the photographic tourist concession of what is now the Nyerere National Park (previously the Selous Game Reserve), declared a World Heritage Site in 2014. Upon arrival at the site, I was chased down by what I initially thought were security police. They had been tipped off that my guide was taking me to see the gorge. Turns out they were actually part of the bid adjudication committee and had come to instruct me to appear at their offices if I was interested in winning the tender. Upon assuring them that I had no intention of bidding, a more relaxed conversation ensued. They confessed that most interested parties, upon seeing the sheer wildness of the setting and the logistical difficulties associated with dropping enough concrete to build a 134m-high wall, simply disappeared. Cause for hope?

My optimism was misplaced. I returned to Nyerere National Park in September 2019 only to be met by trucks barrelling down the main road, kicking up dust and disturbing the wildlife. Perhaps nothing epitomised the contradiction more than the joy of watching young wild dog pups frolicking in a pool alongside this very main road – the conveyor belt of destruction. Beyond that, the country was palpably in the grip of fear. Every taxi driver,

A truck working on the Stiegler's Gorge hydropower project kicks up dust in Tanzania's Nyerere National Park
Photo: Ross Harvey

shop owner and interview respondent expressed their apprehension at voicing any concerns, especially about Stiegler's.

Magufuli had gone ahead despite all the academic literature and feasibility studies cautioning against damming the Rufiji River (again). There are already two dams upstream placing pressure on the hydrological flow into the gorge, compounded by increasingly less rainfall, a partial function of the ravages of climate change. Nonetheless, construction is expected to be complete by 2022.

Not even the World Bank funds hydropower anymore, and most of the world has learned its lessons about the negative impacts of large dams. But Magufuli has bullishly declared that Tanzania – a country pretty much bankrupt and heavily donor-dependent – will self-fund the build. A government spokesperson has stated that the $309.6m required for the initial phase has already been provided.

Magufuli's justification for the project – when he still bothered to provide one – was that access to electricity is woefully low in Tanzania. He has a point. According to the World Bank, only 35.6% of the total population had access, while only 18.8% of the rural population (still a majority) had access. The country's total power generation capacity currently sits at 1,500MW. Magufuli

A pride of lions relax in the Nyerere National Park
Photo: Ross Harvey

(and pretty much no one else) believes that Stiegler's would generate a further 2,100MW on its own. While this white elephant will be the most expensive investment in Tanzania's history, its opportunity costs are where the real expense lies.

A recent policy briefing on the project indicated that if environmental and social costs were considered, but excluding cost overruns and delays, the total cost of the build would amount to roughly $4.95bn, whereas the global average for a 2,100MW project would be roughly $3,74bn. Environmental economists are particularly interested in negative externalities (the divergence between private returns and social costs). In this case, it is near impossible to determine the long-term costs of the downstream environmental devastation that will almost certainly materialise. For instance, oxbow lakes near the coast will likely lose connections that sustain unique fish species. That kind of biodiversity loss is irreversible and therefore cannot be easily costed. Moreover, natural flooding will not be easily replicated or controlled, which will result in nutrients required for downstream agriculture not reaching their natural destination. The risk of food insecurity will arise. Worst, though, is that the delicate ecological equilibrium supporting abundant wildlife will be severely distorted.

One of Tanzania's unique selling points is that the Nyerere National Park is the largest reserve in Africa, roughly the size of Switzerland. It is one of the last wildernesses on earth with an extraordinary array of animal and plant heterogeneity. I had the privilege of spending a night at one of the reserve's six

extraordinary lakes in 2019 – one of the six lakes upstream of Stiegler's Gorge that comprise the primary tourism offering. It is hard to imagine what this area will look like when the dam is built. The sheer increase in traffic volume during the build process is a nightmare in itself, independent of the long-term impacts and resultant opportunity costs. Tanzania would be well advised to do everything possible to avoid foregoing tourism revenue given that it is one of the country's only serious economic propositions (currently accounting for at least 14% of the country's GDP, the impact of Covid-19 notwithstanding).

But what about electricity access for Tanzania's citizens? Two things to consider in closing.

First, the Stiegler's Gorge dam will not deliver as promised. Upstream abstraction and reduced rainfall upstream will affect the flow of water into the dam and hence the volume of power that can be generated. Moreover, global average cost overruns on mega-projects like these are substantial, with one recent study estimating cost overruns of 96% and average delays of 43 months. Hydropower costs alone have risen by 31% in the past decade. The Stiegler's build is expected to take nine years for stage one and three years for stage two. Even if this deadline is met (highly unlikely), the total cost (assuming an annual escalation rate of 3.4%) by 2027 would be $7.58bn. If Tanzania was lucky and only incurred an overrun of 30%, its 2027 cost would sit at $9.85bn. In a word, this is unaffordable for a highly indebted state, especially considering that this is the third year of the project and it's barely started.

Second, there are far more cost-effective options available for securing greater access to electricity that do not rely on the expansion of expensive centralised grid transmission infrastructure (yet to be built). Hydropower is simply no longer a competitive source of electricity generation, especially when the opportunity costs are considered. Moreover, Solar PV farms can be implemented within a year (as opposed to nine years) and deliver electricity at a far lower levelised cost per kilowatt hour. In 2017 alone, China installed 53GW of solar power. There's no reason Tanzania cannot pursue a strategic combination of wind and solar power to generate the 2,100MW that it needs. To quote Dr Joerg Hartmann, an independent consultant specialising in assessing hydropower feasibility, "In combination with existing gas and hydropower resources, solar in particular can provide reliable baseload power, much less exposed to hydrological uncertainty."

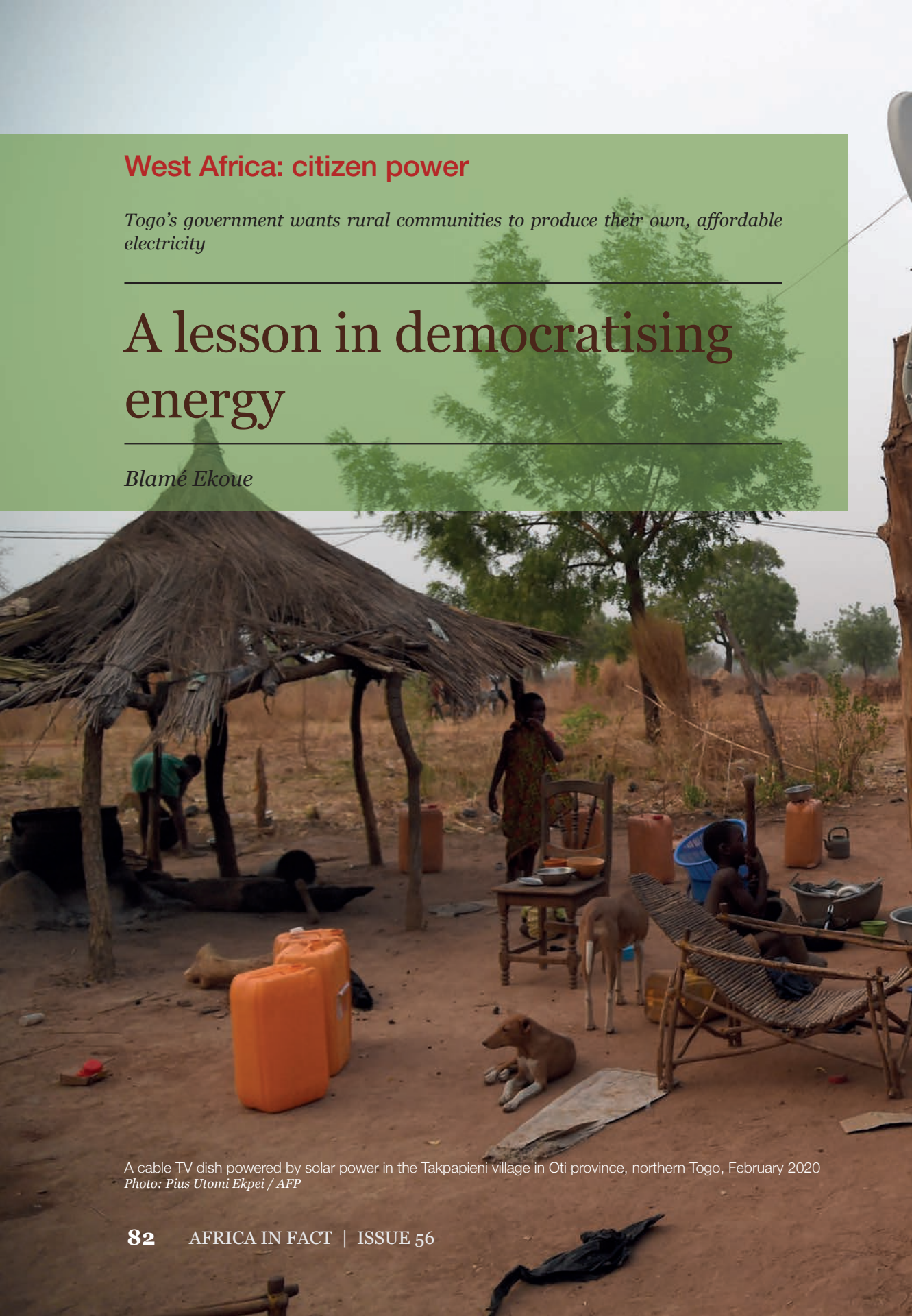
But the "bulldozer" seems unlikely to be persuaded by reason and his legacy will not be one of grandeur. To the contrary, Magufuli's Stiegler's Gorge project will be a white elephant, one that jeopardises the country's tourism offering, kills its wildlife and does not deliver electricity as promised to a citizenry that really deserves better. GG

West Africa: citizen power

Togo's government wants rural communities to produce their own, affordable electricity

A lesson in democratising energy

Blamé Ekoue



A cable TV dish powered by solar power in the Takpapieni village in Oti province, northern Togo, February 2020
Photo: Pius Utomi Ekpei / AFP


PACE

Africa is suffering from a major shortage of power despite having huge potential. According to the World Bank, the electricity access rate in West Africa in 2018 was 52%, with power cuts of up to 80 hours per month. The United Nations has reported that the Economic Community of West African States (ECOWAS), of which Togo is a member, has some of the lowest rates of electricity access in the world, with only about 42% of the total population and 8% of rural residents having access to electricity.

This situation compels countries to come together with common trans-border projects to accelerate electricity access. However, these efforts are complicated by an individual country's own demographic, social and economic circumstances, compounded by shared challenges such as high population growth and rapid urbanisation. Climate change and environmental degradation pose an additional challenge; like many other parts of Africa, a high reliance on biomass such as firewood and charcoal for cooking have contributed to environmental damage and have a particularly negative effect on women and children.

The latest survey shows that 55% of the population had no electricity as of December 2018.

In Togo, the high growth rate has negatively impacted all projections in the energy sector, making it almost impossible for communities in semi-urban and rural areas to access power. According to Togo's national data and economic and demographic studies institute (INSEED), the population will increase from 7.6 million in 2020 to 10 million in 2030, with an annual growth rate estimated at 2.3%. The latest survey shows that 55% of the population – mostly living in rural areas – had no access to electricity as of December 2018.

Faced with this situation, the authorities launched a $1.8 bn national plan in 2018 to provide universal access to electricity by 2030, aiming to make renewables 50% of the country's energy mix by then. This will help to reach more than three million Togolese, most of whom live in rural areas, gain access to electricity through the use of off- and on-grid solutions.

In line with the plan, Togo adopted a law in 2019 to encourage the production and sale of electricity through public-private renewable energy partnerships. Through this new approach, community-based projects are already underway across the country, including CIZO, which means "to light" in the Mina southern dialect of Togo. This project aims to provide more than two million people living in rural areas with electricity via individual solar kits. The solar kits offer a viable alternative to adding these communities to Togo's existing grid, which the country cannot afford to do.

Atta Adam watches cable TV powered by solar energy in his mud house in Tababou village, in the Savannah region of northern Togo, February 2020
Photo: Pius Utomi Ekpei / AFP

It is within the framework of this initiative that Togolese authorities have signed a subsidy agreement with two solar companies, Soleva and Bboxx companies. "We have provided over 2,000 solar kits to households through this partnership. The main goal of the partnership is to reach households in rural areas with our range of solar kits. Today, many communities have electricity through this project. Our solar kits are subsidised," Prince Monsekea, Chief Operation Officer at Soleva told *Africa in Fact*. In all, more than 555,000 solar kits are going to be made available to households in rural areas through this public-private partnership.

Venugné Jean, a rural development engineer, said communities had welcomed the advent of these public-private initiatives. "We are delighted with this vision of public and private partnership because it takes too much time to implement projects if it comes [from] the central government," he said.

Togo's authorities now want to democratise energy, so that low-income communities in rural areas can produce their own electricity at an affordable price. To meet this new challenge, Togo adopted a law in July 2020 to create interest in the renewable energy sub-sector, setting up a well-defined framework for producing clean, quality electricity at an affordable price through private initiatives at the grassroots level. For example, a new pay-as-you-go, off-grid solar concept initiated by Bboxx and Soleva is bringing light to rural households

A technician installs solar panels as part of a community electrification project in rural Togo
Photo: Blamé Ekoue

for the first time. Through the scheme, villagers acquire subsidised individual solar kits on credit and pay them off via several monthly instalments.

"For instance, if they buy our solar kits with three lamps, the customer will pay about $90 instead of $210 because the solar kits are subsidised," Monsekea explained. "We also have kits for five lamps and TV sets. The customers become the owners of the off-grid solar panels after they have paid and they can continue to produce their own electricity without being connected to the electrified-network."

According to Togolese authorities, the scheme is helping to provide affordable energy access to off-grid communities in rural areas. "We want to reach an electricity access rate of 40% in rural areas by 2022. This new concept will help to easily reach all underserved people in rural areas," said Tiem Francois Bodjila, the managing director of the national agency for rural electrification and renewable energies, who will also hold the portfolio of the ministry of water after a cabinet reshuffle in October 2020.

But communities in rural areas still struggling for electricity remain disappointed by unfulfilled central government promises, and see the current democratisation of electricity as an opportunity to take charge of their own destiny. To date, many villages have started their own community-based projects to produce electricity from renewable energy sources.

One example is Amandahome, a semi-urban suburb of the Togolese capital, Lomé, where youths have set up a small biogas plant, which generates electricity from waste.

The community is responsible for the operation and maintenance of the power system, from generation to transmission and the collection of dues. A management committee was set up to control the use of the biogas plant.

"We have set up a management committee whose main mission is to look after the management of the biogas plan. It also supplies the technicians with domestic waste that members of our community collect from houses," explained Marcel Aklesso, the community manager. The biogas plant generates electricity for tenants in the area.

Meanwhile, in Bombouaka, a remote northern village located some 600 km from Lomé, parents organised fundraising to acquire an off-grid solar kit for Yelink primary school. The electricity generated supplies the school's administrative offices as well as the headmaster's house. "We had a lot of problems because there was no light," headmaster Douti Ladekoi told *Africa in Fact*. "So I asked the students' parents to seek an alternative to generate electricity ourselves, because we were never going to be connected to the national network. We held a fundraising event to pay for the off-grid solar kits that light the whole school today."

The emergence of private community electricity projects like these demonstrate that citizens living in rural areas want to play a key role in energy production. Large-scale off-grid production remains a challenge, however, including the human resources needed to manage and maintain bigger projects. "The authorities must take a critical look at community initiatives," says electrical engineer Magloire Nadjombe. "They will play a pillar role in implementing the short, medium and long-term electrification strategy. But they face many challenges; small off-grid components for solar kits they can easily manage but not large-scale production for whole villages."

The emergence of community electricity projects demonstrate that citizens want to play a key role in energy production.

To meet this challenge, more than 3,000 solar energy technicians were trained in 2020 to provide households with assistance throughout the country. And to instill a new momentum into the process of Togo's rural electrification a young and dynamic 29-year-old energy expert, Mawunyo Mila Ami Aziable, who has already proved herself working for multinationals, including GRTgaz and INEO-GDF SUEZ in France, will now hold the portfolio of ministry of mines and energy following the recent cabinet reshuffle. GG

Kenya: vegetable-to-energy

Innovative social enterprises are recycling biowaste into affordable carbon-neutral biomass fuels

A bright future for agro-waste

Justus Wanzala

Amid a monotonous din, Elizabeth Nyamai feeds cubes of peeled and washed tubers into an electric grater. Not even the noise from the grater dampens her determination to process the starch slurry that is dried and sold to food processing companies and other users.

Nyamai is the director of Veliz Foods, a food processing enterprise based in Machakos County, some 60 km from Kenya's capital, Nairobi. Her firm supplies several food manufacturing companies with dried and semi-processed food products for making flour and blending with various food products. Crops processed include cassava, sweet potatoes, pumpkin and African leafy vegetables sourced from farmers in the region.

However, of particular interest is how Veliz dries its food; the firm uses technology from BioAfriq Energy Limited, a Kenyan social enterprise that recycles biowaste, sourced from thousands of farmers in south-eastern Kenya, into affordable carbon-neutral biomass fuels.

Nyamai notes that she has lowered her production costs using BioAfriq's briquettes and a drier bought from the enterprise. "My expenditure on electricity is low, yet I am able to dry my products in large quantities without undermining their quality," she says. James Ivisu, a founder of BioAfriq, explains the biomass fuel is made from discarded crop waste. "We recycle them," he says. The briquettes are sold to farmers who have bought driers, as well as to other users, as a substitute for charcoal, firewood or liquefied petroleum gas.

BioAfriq co-founder Dorine Achieng describes their focus as developing solutions for properly preserving produce, adding value and providing clean energy to households and light industry. Ivisu further explains that farmers in the area have in the past relied on the sun for drying produce, leaving them vulnerable to unpredictable weather patterns. "It is a challenge to dry produce throughout the year," he told *Africa in Fact*.

Biomass fuel is a substitute for charcoal, firewood or liquified petroleum gas.

"Farmers lose harvest that could actually be salvaged. It is estimated that Kenya loses produce worth 150 billion Kenya Shillings annually ($150m)." But, he adds, about 65% of what is lost could be salvaged through improved drying techniques. Ivisu says farmers had resorted to buying ordinary solar driers to preserve their farm produce, but these were unreliable, with drying taking longer and the produce becoming prone to bacteria infestation, which meant a loss of nutrients.

The produce processed with ordinary solar driers also absorbed moisture at night,and drying had to be redone. "It is like defrosting and freezing meat

Left: Elephant grass or napier grass (*Pennisetum Purpureum*) is native to Kenya and is used for biofuel production
Photo: Yves Bernardi

for days on end, which inevitably affects its quality," he says. "Our innovation offers solutions that can dry food faster and evenly, reducing losses even when there is no sunlight."

Ivisu, who initially ventured into chicken keeping, says the high cost of charcoal compelled him to explore viable and affordable alternatives. "I was buying 30 bags in a month at a cost that was depleting my profits," he says. Furthermore, the place he was sourcing the charcoal from was fast losing its tree cover. "It pained me to realise that I was aiding in the destruction of the forest and I had to seek a solution." BioAfriq Energy Limited's venture resonates with other African bio-energy enterprises that support similar initiatives.

Green technological solutions use agricultural waste as well as commercial residues such as weeds and cardboard.

Kobus Venter, the chief executive officer of Vuthisa Technologies, a South African company that offers green technology solutions, says while southern African countries have been rather slow to take up biotechnical products, his company has partnered with the United States-based Legacy Foundation to provide training and technology services for biomass fuel briquette production. Communities in 11 countries have already benefited from the technology, Venter says. The technologies promoted use both biomass and agricultural waste made from agricultural as well as commercial residues such as weeds and cardboard.

Referring to the ever-growing problems of poverty and deforestation caused by the widespread use of firewood and charcoal as energy in the absence of an affordable alternative, Venter says the small network of briquette makers at present does not have the capacity to provide for the level of demand.

Venter points out that entrepreneurs lack access to information and better marketing skills. "They need support for marketing products, branding and processing," he notes. They also require information on assessment of thermal capacity, emissions and standards.

Godfrey Sanga, the East Africa regional director for Energy 4 Impact, a non-profit organisation working with local businesses in East and West Africa to grow sustainable, clean energy markets, agrees that the use of briquettes in sub-Saharan Africa is still limited. "Poultry farmers do use them, but household use is smaller," he says. Sanga points out that competing use of the materials used, for instance in animal feeds, limits the availability of stock. "Lack of appropriate briquetting technology is another limitation," he says.

The cost of purchasing and importing, operating and maintaining briquette-

Elizabeth Nyamai in her facility that processes tubers for the food manufacturing industry
Photo: Justus Wanzala

making machines, tax and duties are also a barrier to expanding production. There are other challenges to expanding the market and encouraging demand: long distances between producers and consumers mean high transportation costs, for example.

Sanga does, however, believe there is scope to expand and upscale briquette manufacturing, suggesting linkages between potential agro-waste briquette manufacturers and potential buyers to enhance the exchange of information. There is also a need, he says, for further research into creating higher quality

product and standardising machinery. "At the moment, there is variation in quality and performance specifications such as calorific value, density, ash content, moisture content and size," he observes.

Kevin Gikonyo, the social entrepreneurship lead at Hivos East Africa, an organisation that supports transitions towards renewable energy, says they implemented a briquette production programme in the Somali regional state of Ethiopia and have learnt valuable lessons.

The project uses the Jatropha plant (Jatropha curcas) and other invasive species in the region to make briquettes, and there are plans to introduce bamboo. "We [have] targeted refugees and host communities on a 50:50 grant share allocation in the Deka-suftu, Suftu and Dollo Ado areas," Gikonyo says, adding that the project has included the technical skills transfer of entrepreneurship expertise, briquette production and the manufacturing of fuel-saving stoves and their parts.

Briquette production has reduced environmental degradation and means fewer chores for women.

The three-year project, supported by the Netherlands Enterprise Agency among other donors, ends in early 2021. "The overall impact so far has been reduced environmental degradation, and means fewer chores for women used to travelling distances to fetch firewood," says Gikonyo.

While widespread use of the technology is still some way away, Venter's optimism suggests a bright future for agrowaste as a source of clean energy in Africa.

"Maybe this is foolish to western trained business managers, but when it works, it works well. It is in a way, a real benefit to being on the front edge of the growth of a new process for combating climate instability," Venter says.

For BioAfriq Energy Limited it is about affordability, environmental conservation and food security. Veliz Foods is a witness to a green promise. GG

Africa in Fact cartoon

Victor Ndula

Malawi: wind and solar

It took a poor rural schoolboy to demonstrate how Malawians could power their own way

Harnessing the elements

Collins Mtika

In his bestselling memoir, *The Boy Who Harnessed the Wind: Creating Currents of Electricity and Hope* (2009), William Kamkwamba laid bare the challenges faced by millions of Malawians living in rural areas without access to electricity.

Kamkwamba's epic memoir, in which he recounts how, forced to drop out of school at 14 because famine had ruined his family's harvest leaving them unable to pay his fees, he used books from the local library to teach himself how to build a windmill using scrap materials to generate electricity.

His innovation and determination to provide his village, Kasungu, with electricity and water garnered first national and then international attention. Today the teenager, whose story culminated in a book and a film (available on Netflix) is still changing lives through his Moving Windmills project. The Enviromental Studies graduate and entrepreneur and his Moving Windmills project have a long-term plan to distribute power using low-cost technologies, which will be anchored by solar, wind and rivers (mini-hydros).

The challenge is huge. Some 83% of Malawi's population of approximately 19 million people lives in the rural areas. Online energy portal Energypedia noted in a 2020 report that: "Malawi's National Energy Policy estimates that 93% of total energy demand is met by biomass. Households consume 84% of the total primary energy. A staggering 99% of household energy is supplied by biomass... Less than 2.3% of the total national energy demand is met by electricity, 3.5% by liquid fuels and gas, and 1% by coal."

It is estimated that 93% of Malawi's total energy demand is met by biomass and households consume 84% of the total.

Energypedia's report said that only 18% of the population had access to the grid, while the almost blanket use of charcoal and firewood for domestic use is "exerting significant pressure" on the country's forest resources.

A 2017 study, published in the Proceedings of the National Academy of Sciences (PNAS), found that Africa has huge untapped resources of renewable energy, which should be used to meet increased demand.

Meanwhile, the Malawi Renewable Energy Strategy estimates that the country could actually connect 27% of the population by establishing decentralised mini grids in communities of 250 people located at least 5 km from the national grid. However, since the Malawi Rural Electrification Project (MAREP) rolled out 40 years ago, 96% of the country's rural population still remains off grid. At the present rate, Malawi needs at least 960 years to connect every rural home or institution and achieve energy for all.

One of William Kamkwamba's first windmills in Malawi
Photo: Tom Reilly

"I'm very interested in finding ways to use the knowledge that I have gained through my education and interacting with people to solve some of the problems people are facing in Malawi," Kamkwamba told *Africa in Fact*.

Malawi's Department of Energy Affairs agrees that the country cannot eliminate the huge unmet need for electricity by extending the national grid alone. The country's revised National Energy Policy recognises the challenges of continually extending the grid because some rural populations live in hard-to-reach places. Instead, the policy recommends that Malawi diversify the generation and distribution of electricity by embracing the use of solar, water and wind mini-grids to accelerate rural electrification.

"Rural access is to us still on the lower side; we wish we could have done more [by now]. The 2018 census shows that 84% of people in Malawi live in rural areas. This means we are still doing them a disservice," Edgar Bayani,

William Kamkwamba attends the premiere of the film "The Boy Who Harnessed The Wind" at the Sundance Film Festival, January 2019
Photo: Rich Fury / AFP

the Director of Community Energy Malawi (CEM), says.

Bayani suggests that Malawi's energy woes would be met if the government operationalised key policy documents such as the National Energy Policy, Renewable Energy Strategy and Action Agenda.

Kamkwamba, meanwhile, is actively pursuing his ambition to assist Malawi by coaxing a cadre of youngsters to embrace innovation from a very young age. This includes the creation of an innovation centre in Kusungu, which will be a hub for "students, mentors and community to create innovative solutions to Africa problems".

"We talk about wind and solar because it's a simpler and cheaper way to give us electricity and irrigation," Kamkwamba says. "Clean water and power are our right as humans on this earth, and for too long our governments in Africa have failed to provide these things."

The Moving Windmills project is working with five primary and secondary schools in Kasungu to solarise their power and has installed internet-in-a-box systems, with the primary goal of bringing consistency to every school day for hundreds of students.

Solar panel installations allow students to study late into the might and to use computers for the first time in their lives.

"We have been able to build three classroom blocks with two classes each for the local primary school," Kamkwamba says. "These new classrooms have solar panel installations that allow the students to study late into the night. We have also installed solar panels and systems in Kachokolo High School, which has allowed the students to use computers for their studies for the first time in their lives."

Malawi needs to invest $3 billion to leverage abundant renewable energy resources to save money, while providing reliable electricity for growth and rural electrification, according to a 2019 study by the Rocky Mountain Institute.

"Malawi has an abundance of resources with which a sustainable energy sector could thrive. Ending energy poverty and ensuring that no country or person is left behind must become a priority for all stakeholders," the study said.

Malawi has an abundance of resources with which a sustainable energy sector could thrive.

David Keith, an African energy sector expert at Tetra Tech International Development Services, agrees that billions of dollars in investment in Africa's electricity sector are needed.

"The key here is we really believe the energy sector is just another industry—it is not a government enterprise. And if we could get that sort of belief across, then governments will get out of the power business," said Keith, who has worked on energy projects in South Africa, Malawi, Uganda, Ghana, Benin, Tanzania, and for the West Africa Power Pool.

To augment Kamkwamba's efforts in powering and lighting Malawi, the country's government is now working with Independent Power Producers (IPPs) to help the country in power generation endeavours. It has engaged 14 IPP companies to generate solar power and others to use wind, geothermal, waste and coal.

Helping to fill the energy void in his home village and lessening energy poverty, Kamkwamba's Moving Windmills Foundation established a biogas digester project in Kasungu that uses cow dung to generate gas, which is used for cooking and lighting homes. It has also taught villagers how to fix water wells to avoid cultivating diseases that come from lack of maintenance.

"Deforestation is a huge problem in Malawi, which only adds to the problem," he said. "People cut down trees because they have no power to run electric stoves, etc. So, they use firewood. This is a problem all over Africa. The windmills don't produce enough power to operate a stove, but with some more innovation, this could be easily solved."

Kamkwamba still regularly speaks at conferences and other events where he continues to explore various renewable energy sources that could have the potential to help Malawi.

"Africa is blessed with renewable energy and does not need fossil fuels to help people access energy and create growth, and the cost of renewables has come down significantly and is much lower than that of fossil fuels," Mohamed Adow, the founding director of the Nairobi-based think tank Power Shift Africa told *Africa in Fact*. GG

Rural healthcare: lights on

Mini-grids and solar systems are a lifeline for Africa's underserviced rural health clinics

Solar in a suitcase

Munyaradzi Makoni

Laura Stachel first realised that lack of electricity impaired the delivery of life-saving care when she conducted research in a state hospital in Nigeria in 2008.

As an obstetrician, she watched helplessly as her colleagues struggled to deliver babies in near darkness, administer intravenous medication by candlelight and conduct surgeries by the ambient light of windows or by flashlight. Resuscitating newborns in a hospital where light and electricity were only available 12 hours a day was tough.

With her husband, Hal Aronson, she designed a standalone solar electric system for the hospital and provided a solar-powered blood bank, and as a result, maternal deaths dropped significantly.

"We witnessed the impact of solar electricity on medical and surgical care," she told *Africa in Fact*. "Soon, surrounding Nigerian health facilities began asking me for solar power, and I knew we needed a solution that could scale."

Out of that, a solar suitcase, a rugged, compact solar electric system for maternal healthcare facilities in need of an immediate and reliable source of electricity, was born. Equipped with medical-surgical lights, headlamps, phone charger, a foetal doppler to assess the foetal heartbeat, and charging ports for other devices, the suitcase became a lifesaver.

Now, under We Care Solar, the suitcase is used in 20 countries, mainly those with high rates of maternal mortality and low access to electricity, initially in Liberia, Uganda, Sierra Leone and Zimbabwe, and latterly in Ethiopia, Nigeria, Tanzania, Eritrea, Mozambique, Gambia, and Ghana.

The suitcase allows health workers in energy-poor regions to assess patients for signs of infection, conduct examinations, make cell phone calls for consultations or patient transfer, adhere to infection control protocols and avoid cross-contamination.

A midwife shines a light on a patient
Photo: We Care Solar

And, when the COVID-19 pandemic hit Africa, the solar suitcase found added meaning. "We added infrared no-touch thermometers to the solar suitcase to assist in the detection and monitoring of patients with infection," Stachel said.

The solar suitcase is useful for primary care providers during COVID-19, she added. Light is essential for examining patients, diagnosing medical conditions, and performing procedures.

It is no surprise that when COVID-19 hit Liberia in April, Bentoe Tehoungue, the director of Family Health at Liberia's Ministry of Health, sent an SOS asking for electricity and light. In sub-Saharan Africa, only 28% of healthcare facilities benefit from reliable electricity, says Sustainable Energy for All.

In sub-Saharan Africa, only 28% of healthcare facilities benefit from reliable electricity.

For Tehoungue, after five months, the only response for help came from UNICEF, providing direct support for the neonatal and paediatric unit at the James David Memorial Hospital, near Monrovia, the capital, which included equipment and solar power.

"Everyone knows that when you are in the dark, you are bound to make mistakes and have cross-infection," Tehoungue told *Africa in Fact*. This means there is a risk of spreading infections between patients as well as a risk of infecting yourself, she added.

During the pandemic, hospitals in Monrovia, Grand Bassa and Marpula were treating patients with COVID-19 in facilities that rely on an unstable supply of grid electricity supply, Tehoungue said. "They mostly depend on generators," she added, pointing out that solar power was more sustainable, whereas generators continuously needed fuel and maintenance.

Light is essential for examining patients and diagnosing medical conditions
Photo: We Care Solar

Long before the pandemic, in 2018, the United Nations Development Programme (UNDP) had provided solar electricity to five hospitals and health centres, and discussions to scale up the solar electrification of hospitals were ongoing, said Tehoungue.

Unsurprising then that solar systems or mini-grids have become a lifeline to underserved rural health clinics, especially as COVID-19 cases surged across Africa.

In the past eight months, at the time of writing in October, health services in several African countries had been connected to solar. For example, 10 clinics in Zimbabwe's Matabeleland North Province were lit through a donation of

solar panels and accessories from local solar company, Zonful Energy, to assist in the fight against COVID-19.

In Tanzania, JUMEME, a local mini-grid operator co-funded by the EU, used its local solar-hybrid mini-grids to provide 10 healthcare facilities in the Lake Victoria Islands, with free electricity services for three months.

Meanwhile, in Nigeria, The Rural Electrification Agency installed the largest solar hybrid power plant in Abuja, with a capacity of 53.1kW, providing electricity to the isolation centre at the University of Abuja Hospital and 30kW solar hybrid systems serving two isolation centres with more than 200 beds combined in Ogun State in south-east Nigeria.

"Reliable power supply has ensured that core systems for the management of health programmes function effectively," Saleban Omar, head of UNDP's Solar for Health Initiative and its senior regional programme advisor for Africa, told *Africa in Fact*.

Uninterrupted systems for data input and analysis contribute to efficient and accurate quantification and distribution of medicines, patient tracking, and monitoring of overall health system performance, Omar said.

In Zimbabwe, for instance, where Solar for Health initiative operates, many clinics had only four hours of power supply a day. The programme partnered with the Global Fund in equipping 405 health facilities with solar panels, which meant that "people can get the healthcare they need when they need it", said Omar.

Through solar power the clinics can increase the access to quality health services, including safe delivery for pregnant women.

With solar power, the clinics can now maintain the quality of temperature-sensitive medicines, safely sterilise equipment and store vaccines, while also increasing access to quality health services, including safe delivery for pregnant women.

Reports from Zimbabwe, Omar said, showed a growing number of pregnant women and children under five years old accessing rural health facilities, with some clinics reporting an increase of up to 80%. The Solar for Health initiative has enabled clinics to extend their hours of operation, as well as enable better retention and recruitment of healthcare workers in remote settings, ensuring effective, safe healthcare, 24 hours a day, seven days a week, he said.

Apart from Zimbabwe, the initiative has supported more than 900 health centres and storage facilities in Angola, Chad, Liberia, Libya, Namibia, Nepal, Sudan, South Sudan, Yemen, Zambia, and Zimbabwe, in the past two years.

In May 2020, Power Africa, under the auspices of USAID, launched a Solar Electrification of Healthcare Facilities grant competition to "support

accelerated provision of off-grid energy and reliable power solutions to improve the readiness and resilience of healthcare facilities in rural, peri-urban and urban communities of sub-Saharan Africa". Grants range from $100,000 and $500,000.

Omar said that to keep solar running, they are seeking funding from the Green Climate Fund to design a climate change mitigation programme known as the Solar for Health Programme, enabling the provision of sustainable low-carbon energy services to public health facilities in sub-Saharan Africa.

The proposed programme will design and implement performance-based payment models for solar-powered solutions to provide clean, affordable, and reliable energy services to health facilities. It will also establish a regional knowledge platform on climate change and health.

Omar said they would continue supporting public health institutions through direct procurement and by offering reliable and timely delivery of quality-assured products, while helping governments to build sustainable and resilient health systems and improve national procurement and supply chain systems.

"We also provide technical expertise to strengthen policy and regulatory frameworks, improve procurement strategies and regulations, and address potential barriers to equitable access to affordable medicine," he said.

However, the UNDP's Solar for Health initiative is not without its challenges. The programme has had to contend with the unavailability of appropriately skilled manpower, enabling environments, and lack of finance. These were just some of the biggest challenges facing the solar sector in some of the countries the programme operated in, Omar said.

The initiative partnered with the Physics Department of the University of Zambia to establish a Solar Energy Centre of Excellence that supports the growth of the solar energy industry through training, testing of equipment, and physical deployment of PV technologies in health facilities.

The biggest challenges facing the solar sector are unavailability of skilled manpower, enabling environments and lack of finance.

"We continue to promote sustainable health procurement by working together with manufacturers on social and environmental scorecard assessments, reducing CO2 emissions through enhanced data collection and analysis of shipments, and through medical waste management and packaging optimisation of health products," Omar says. GG

Book review

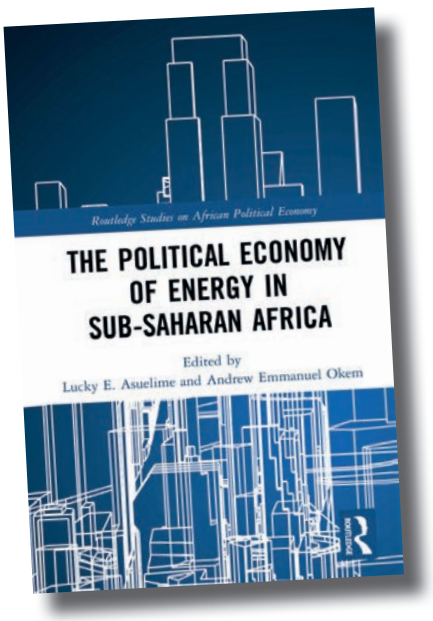
The Political Economy of Energy in Sub-Saharan Africa, edited Andrew Emmanuel Okem and Lucky E Asuelime, published by Routledge, London and New York, 2018

A paradox of poverty

Yunus Momoniat

In pre-industrial society, one used wood and fire for heat and light, gathering wood from the environment on a more or less sustainable basis. But industrialisation has made energy an issue of state, and if states fail to procure and provide energy to vast populations, poverty, disease and death await.

Access to electricity, in the 21st century, is about as important as access to food, shelter, health and employment, and plays a significant role in securing access to these basic conditions of life itself. Access is a critical factor in improving life chances, in escaping poverty, and a hundred years after electricity came into general use, it is still a scarce resource for almost a quarter of humanity.



This is why a book such as *The Political Economy of Energy in Sub-Saharan Africa* is an important text, despite its academicism and occasional obscurities.

The book covers a range of topics related to its title, with political economy fairly ambiguously defined, allowing for certain issues not strictly falling under its rubric – such as governance, gender relations, ecological social work and development issues – to be included in the collection.

A chapter on gender relations and land use in Zimbabwe focuses on the marginalisation of the rural women of the Gokwe region, where cotton and maize production are the main sources of income. The authors show how women's successes are stolen from them during

the production process, made possible by a complex web of polygamy and an unfair tenure system that denies especially widows their rightful inheritance. They call for reform of gender-blind laws and legislative interventions by government.

A paper on ecological social work in South Africa borders on the obscure, seeing its task as enhancing the "co-existence and interdependency [of the] biodiversity relationship between humans and nature". The authors are concerned with raising communities' awareness of the benefits of ecological conservation, but they seem to limit the idea to the recycling of waste.

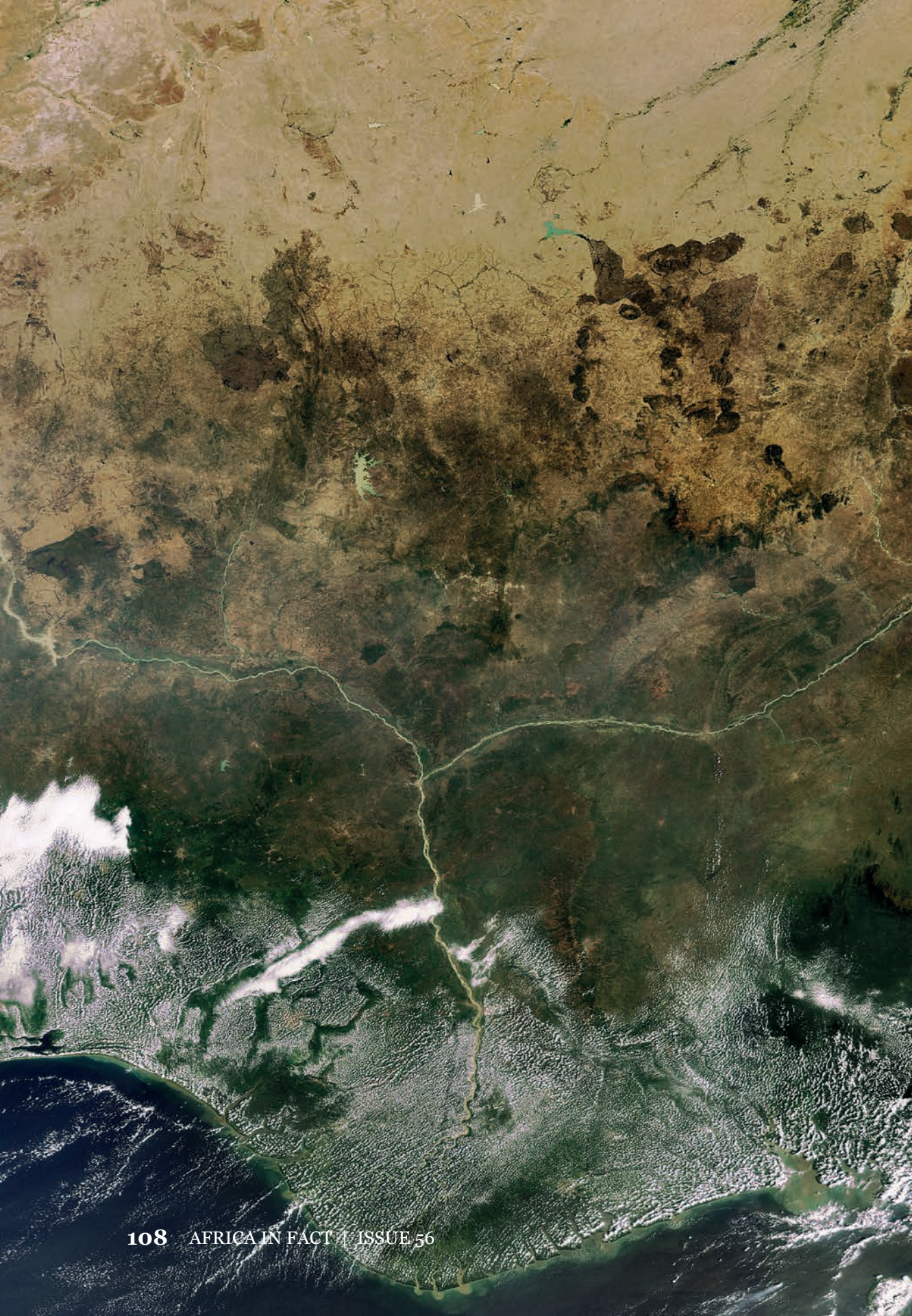
A more interesting chapter looks at the question of sustainable energy supply in Zambia, which has recently been plunged into darkness and a regime of load-shedding, a situation that seems to be affecting more and more countries on the continent. Energy is deemed sustainable if it does not deplete its source and degrade the environment. Zambia relies mostly on hydropower, but droughts severely affect output, as does bad governance, climate change and the degradation of energy sources such as forests.

Energy is deemed sustainable if it does not deplete its source and degrade the environment.

Another chapter explores the manner in which affordable energy makes pro-poor development easier to pursue. It adopts the UN Millennium Development Goals as the framework for the fight against poverty in Ghana. The author, David Anaafo, gives an account of Ghana's many energy crises, beginning in 1983, which have had grave effects on the people, and set back efforts to reduce poverty. Predictably, Anaafo argues that access to energy improves incomes, education, social participation, gender equality, health and the sustainable use of natural resources.

The book presents four chapters on various aspects of the energy issue in Nigeria. The country has an abundance of coal, which provided 80% of Nigeria's energy until 1957/8 when it dropped to 64%, but by 1987, coal mining was halted. Specialist contributors Uchenna Ani and Kelechi Ani argue that coal has been underutilised in Nigeria, and that greater use of coal would spur industrialisation and create thousands of jobs. This contention is at odds with the overall stance of the book, which generally argues for a transition to cleaner forms of energy.

Another chapter is more in keeping with the book's stance, setting out the disastrous effects of the oil industry on the Niger Delta, a region that has been neglected by successive governments while suffering much ecological damage inflicted by the industry. Friday Aworawo argues that the persistence of civil



disobedience and even threats of secession in the region are the result of extensive degradation of the environment, of farming land as well as rivers and dams by oil companies such as Shell and Chevron.

Segun Joshua and Opeyemi Akinyemi examine the vicissitudes of fuel subsidies in Nigeria, showing how these have become a tool for politicians rather than a way to ease the plight of consumers. The removal of subsidies is often met with protests, and once in place, subsidies are almost impossible to dislodge. But they allow cartels to milk the federal government, bribe politicians and even control political institutions. The authors list other writers' objections to subsidies, saying their removal will narrow opportunities for corruption, temper inequality, increase economic development and make way for green alternatives.

The clearest picture of Nigeria's woes is set out by Olawale Olaopa, Yusuf Akinwale and Ibikunle Ogundari in their examination of governance institutions – more accurately, of the lack of these and the networks they should ideally form to oversee the energy industry, particularly petroleum production. They argue that proper and efficient governance is essential for every aspect of the energy question, from production, distribution, implementation of policy, revenue collection and recording, to administration and management.

The biggest challenges facing the solar sector are unavailability of skilled manpower, enabling environments and lack of finance.

The trio show how the lack of coordination between federal structures, and between tiers of government, result in mismanagement, theft, corruption, recessions, and – more dangerously – protests, secession movements and political instability. They recommend the creation of appropriate institutions, the development and funding of local capacity, the devolving of overly centralised structures and increased consultation with local actors.

The book's editors, Andrew Emmanuel Okem and Lucky Asuelime, characterise sub-Saharan Africa (SSA) as having, despite many resources, "massive poverty, low literacy, low life expectancy, poor infrastructure and high maternal and infant mortality" – a "paradox of poverty in the midst of abundance". Confounding the situation, as other papers attest, the region's political landscape is rife with "corruption, human rights abuses, clientelism and patronage politics".

Climate change has worsened these problems, and SSA is projected to "experience the most negative impact of climate change". Okem spells out the oft-researched connection between energy availability and socio-economic

Left: The Nile delta, Envisat satellite image, 2007
Photo: European Space Agency

development, and points out that since awareness of climate change came into our consciousness, traditional energy sources have been revealed to have myriad negative effects on development, as they pollute the environment and accelerate climate change. He stresses that improvements in patterns of energy consumption have been linked to poverty reduction.

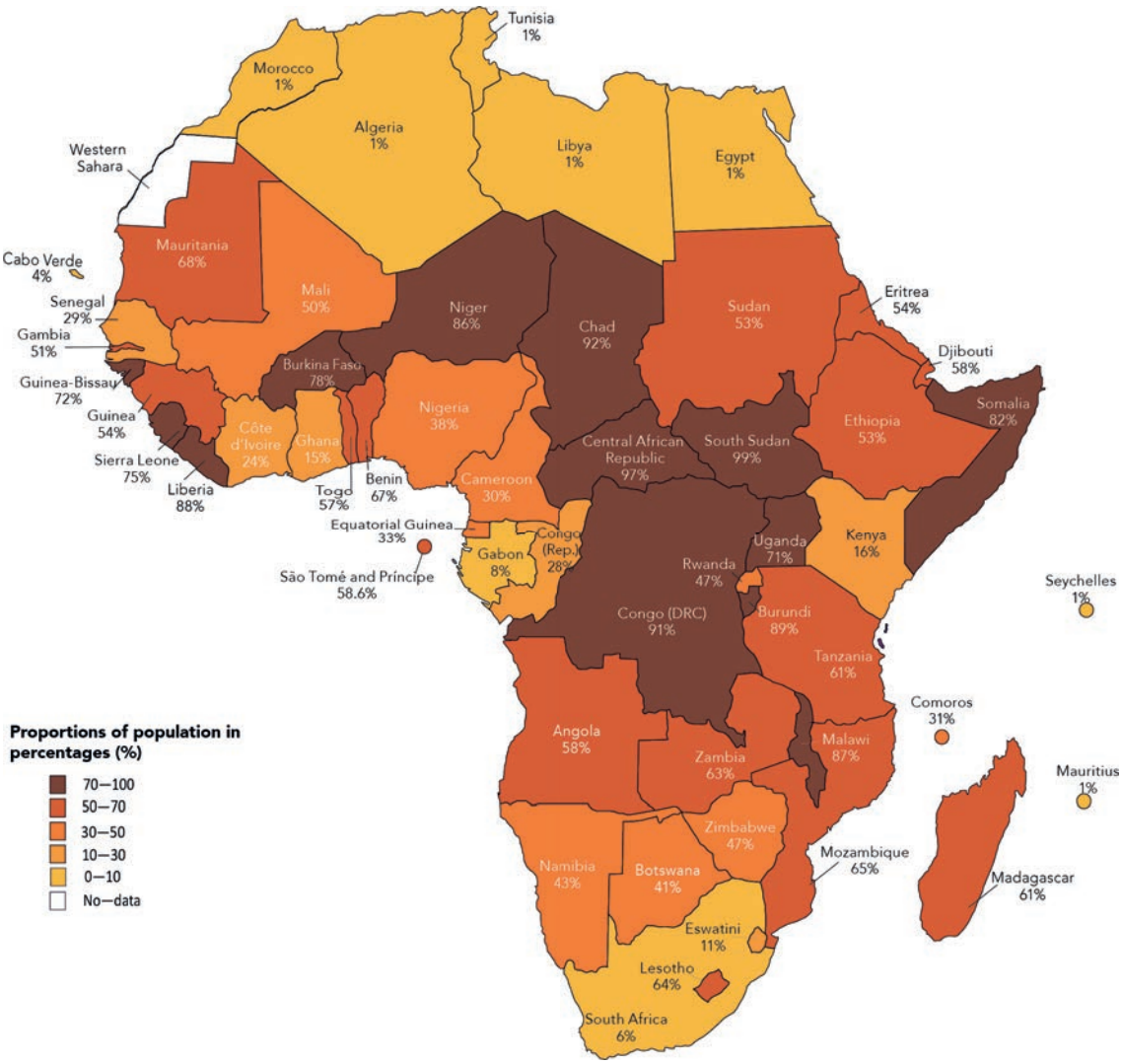
The editors agree that the energy sector is poorly governed in sub-Saharan Africa.

Lamentably, in SSA reliance on dirty energy is widespread, with many using biomass as sources of heat and lighting. Charcoal has become not only a source of energy but a means of livelihood. Thus the cycle of environmental degradation, deforestation and unhealthy outcomes is intensified. It is no wonder that governments have tried to regulate charcoal production, some even banning it outright.

With urbanisation rates faster than anywhere else in the world, people migrate to cities and improvise, creating shelters that become informal settlements choked with smoke-emitting pollutants detrimental to health.

The editors agree with the other authors that the energy sector is poorly governed in SSA, and political instability, corruption and patronage prevent the emergence of a stable energy market, and deter investment in the sector. The failure of governance means that the transition to green alternatives is strewn with obstacles. The lack of investment also means a lack of beneficiation, making processing companies in developed countries beneficiaries in a situation that makes for a vicious circle.

The failure of Africans to benefit from the region's many resources has led to wars and armed conflicts, and the resurgence of terrorism is connected to this competition for vital resources. It will take many years and the efforts of many forces to dislodge those whose interests are served by the status quo to arrive at a fairer, greener and more humane distribution of energy in the region. GG



Proportion of the population without access to energy, 2019

Source: IEA, World Energy Outlook, 2020

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