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Fixing the Disconnect Around Energy Access

The divergent fates of two community mini-grids in Nigeria illustrate why energy systems should be built to enable economic transformation.

Over the past two decades, the United Nations, the World Bank, regional development banks, and national governments have led efforts to give more people access to electricity. The movement has made significant gains: in Asia alone, about 1.2 billion people have gained electricity access since 2000. Still, these initiatives to extend energy access globally are not delivering much-needed outcomes in pace, scale, and improvements in quality of life. Today, in 2022, around 770 million people do not have access to electricity. More tellingly, 2.6 billion people use wood, coal, dung, and kerosene stoves to cook indoors, leading to approximately 2.5 million premature deaths from smoke every year.

Providing access to affordable, sustainable, and modern energy services has the potential to be transformational. Improved access to energy could alleviate poverty, improve health and gender equality, and address climate change, among other objectives that the United Nations has defined as Sustainable Development Goals (SDGs). However, around 600 million people in sub-Saharan Africa are projected to remain without access to electricity in 2030. And most of the countries that have yet to achieve universal modern energy access also rank low in their climate change adaptation capacities. Addressing this dire scenario requires more than the standard prescription of energy access—and will entail a transformation in policy to deliberately lift communities out of economic poverty.

To accomplish this, we believe that energy access should be coupled with the provision of tools for economic empowerment, enabling people to use energy to increase their income. Historically, energy programs have focused exclusively on energy delivery to households, a focus that has not resulted in bringing families out of poverty and may frustrate the accomplishment of other SDGs. A study conducted in India and Kenya by the Institute of Development Studies, the Energy and Resources Institute, and Practical Action Consulting found no direct relationship between level of electricity access and poverty reduction.

To understand why energy access programs have not fully delivered on their promise—and how they could—it's necessary to look closely at how such programs play out on the ground. Here, we focus on Nigeria to illustrate the challenges faced in many countries. Nigeria has the largest economy in Africa and possesses significant energy resources, yet it is the country with the most people without any access to electricity—approximately 85 million people out of a population of 206 million. Projected to become the third most populous country in the world after India and China by 2050, Nigeria has a pressing need to accelerate both energy access and poverty alleviation. Since the return of democracy in 1999, there have been significant efforts to improve the country's energy sector, and so the country offers illustrative examples of how energy access projects fail—as well as why some succeed.

An energy disconnect

Igbatoro is an agricultural village located in South West Nigeria that grows mainly cassava, a root that is then processed into a coarse flour known as *garri*, which forms the base of a variety of dishes. The community uses diesel-powered machines to process the cassava. For lighting, the community depends mainly on kerosene lanterns and dry cell

Wired and CERN

Steve Miller

On a trip to Brazil, artist Steve Miller was captivated by the tangled web of power lines in Rocinha, Rio de Janeiro, the largest favela in the country. Lacking access to basic services, residents tap into overhead cables, risking electrocution in the process. He photographed the wires and incorporates those images in his prints and paintings, thinking of the wires as "human drawings in three dimensions in space, based on our urgent need for resources."

On the other side of the world, in Geneva, Switzerland, is CERN, the European Organization for Nuclear Research, where physicists and engineers use some of the most advanced scientific instruments to study the basic constituents of matter: fundamental particles. In Miller's works, he incorporates mathematical equations and diagrams sketched out on chalkboards in CERN laboratories, making connections between the rapidly drawn chalkboard lines and the complex electrical networks that power CERN's vast magnetic fields.

The electrical wire imagery and CERN equations coexist in Miller's layers of ink and paint. The highly organized conduits that power CERN may seem like the antithesis of the chaotic, impromptu power lines of Rocinha, but both explore energy on a macro and micro scale. From an aesthetic perspective, the CERN chalkboard diagrams and the favela wires contain the same visual chaos. "Where a physicist sees knowledge, this artist sees abstraction," Miller writes.

Based in New York, Miller is recognized as an early pioneer of the "SciArt" (science-based art) movement. In 2013, the National Academy of Sciences (NAS) mounted his exhibition *Crossing the Line*, featuring paintings based on his collaboration with neurobiologist Rod MacKinnon. In 2017, NAS mounted his exhibition *Health of the Planet*, which included paintings, prints, and sculptures exploring the deforestation of the Amazon and the impact on the fauna living there. His forthcoming book is *Surfing the Cosmos* (G Editions, 2022). Follow Steve Miller on Instagram @stevemillerdotcom and see more of his art at https://stevemiller.com.

STEVE MILLER, *Data That Did*, 2018, inkjet, pigment dispersion, silkscreen on canvas, 22 x 16.25 inches

battery torches. Soot from kerosene lanterns and diesel generators are harmful to human health and are incompatible with climate action.

Igbatoro is remote and has difficulty accessing urban markets because of the condition of its roads. In 2017, a private company working as a social enterprise project installed a solar mini-grid, providing 20 kW of power, near a *garri* processing area of the village. After installation, every household in the community was connected to the grid. The hope was that the farmers would transition from using diesel-powered cassava grating machines and other manually operated machines to using electric-powered machines.

However, the electricity did not bring about these expected transformations. Most households used the electricity only for lighting. Lacking access to financing for new equipment, farmers continued using their diesel-powered cassava processing machines. And although the arrival of electricity had been promoted as a way out of poverty, residents' incomes were so low that they were unable to invest in goods such as sewing machines that could potentially raise their incomes. The town's distance from markets meant that most farmers earned only a seasonal income. Soon, residents of Igbatoro realized they could not afford the cost of electricity at all.

Within four months, every member of the community had disconnected from the solar mini-grid because they couldn't afford the cost. They returned to using kerosene lamps—and living amid both diesel exhaust and cooking smoke—and progress toward the other SDG goals was lost. The solar farm itself was dismantled and moved elsewhere by the company that had installed it.

When researchers spoke with members of the community, they learned that although a feasibility study had been conducted prior to the mini-grid's installation, there had been no clear considerations for a viable sustainability plan. Basic questions such as who would use the infrastructure and what they would use it for were never discussed. Astonishingly, the community was never asked if they would be willing to pay for electrical services. Ultimately, the people of Igbatoro said that the infrastructure did not address their real need, which was to increase their incomes to the point where they could purchase electricity.

Beyond passing electrons through wires

As this example shows, the challenge of providing energy access goes beyond passing electrons through wires. Historically, programs that have focused on increasing energy delivery have paid too little attention to improving lives, eradicating poverty, and improving economic empowerment through productive use of energy. This historical trend has limited, in various ways, the socioeconomic and developmental impact of access to energy. Now there is a need to rethink the existing energy access frameworks to include economic empowerment programs. More scholarship is needed to investigate whether economic empowerment can engender sustainable energy access and promote other SDGs to inform future energy policymaking.

Economic empowerment programs, at the broadest level, support activities that lead to income generation. More specifically, such empowerment demonstrates to people that their value is being recognized, respected, and rewarded fairly. These programs may include formal and informal jobs, skills development, financial services, and market information, as well as microcredit schemes that provide loans to low-income households so they can grow more food, for example, or make money by processing it.

We argue that coupling dedicated energy access programs with an economic empowerment component may yield better results than programs dedicated to energy delivery alone.

Integrating energy access and sustainable development

When the United Nations established the SDGs in September 2015, it precipitated a shift in international policymaking frameworks. Because the SDGs are integrated and interdependent—the successful realization of one may promote the realization of another—these goals cannot be viewed in isolation. In a 2017 meta-analysis of more than 100 studies involving energy access, David L. McCollum and his colleagues argued that there are positive linkages between the energy and the nonenergy SDGs, which include poverty eradication, zero hunger, good health, quality education, gender equality, clean water, and decent work. Moreover, they posit that the positive linkages outweigh potential negative ones—such as the effect of utilizing renewable bioenergy on food production—both in number and intensity. As the researchers write, energy access is "a necessary (but not sufficient) condition for delivering the type of services fundamental to escaping the poverty trap: education, employment, and quality healthcare."

We can zoom in to see more clearly some of those positive linkages of energy access and other non-energy SDGs. Access to modern energy (electricity and clean cooking fuels) frees up resources for other income-generating activities. It can also support agricultural productivity by providing the energy needed to reduce postharvest losses, by powering cold storage for fruits, for example—which in turn aids food security. In terms of health, electrification can reduce smoke-related deaths and provide the means to access clean water. Electrification is also central to climate change mitigation as it helps reduce the use of diesel-powered motors and generators that contribute to greenhouse gas emissions. If that electricity comes from low-carbon sources such as solar panels, it may reduce fossil fuel use even further.

Igbatoro's experience demonstrates that energy access programs alone are not enough. This is not a trivial consideration. By 2017, Nigeria's Rural Electrification Agency (REA) alone had overseen the installation of 2,800 mini-grid and solar hybrid projects. In 2018, international agencies provided REA with an additional $350 million to continue this work.

In order to provide sustainable energy access and realize other SDGs, we believe that the issue of economic empowerment should be addressed first. This can only be done if energy access projects are designed to improve livelihoods, which means aiming programs at revenue-generating activities rather than households. Here, we find it useful to consider energy and development consultant Kamal Kapadia's definition of productive uses of energy as the "utilization of energy—both electric, and nonelectric energy in the forms of heat, or mechanical energy—for activities that enhance income and welfare."

An illuminating success story

To understand how successful mini-grid programs enable economic empowerment, consider the community of Kigbe. Located in the Federal Capital Territory in North Central Nigeria, Kigbe's residents are mostly farmers whose crops include sesame seeds, maize, sorghum, guinea corn, and cassava.

In 2017, a company working with Nigeria's REA installed a 20 kW solar mini-grid that powers 145 households, 5 wells (providing clean water to the community), and several businesses. The businesses include a computer center (which provides typing, printing, and photocopy services as well as computer appreciation courses), two grain grinding/processing businesses, and several microbusinesses that sell cold sodas. The mini-grid also powers a rural clinic that serves Kigbe and other neighboring communities. The grid currently operates at about 50% of capacity.

After doing fieldwork in the town, it became clear that the success of the Kigbe project is the result of intensive citizen participation. For three years before installation, the solar company tried to understand the real needs of the community and how providing energy infrastructure could address those needs—while also enabling other economic

STEVE MILLER, *Intervention*, 2021, inkjet, pigment dispersion, and oil on canvas, 53 x 40 inches


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activities. In part, the program succeeded because the people of Kigbe had the opportunity to imagine what they would do with electricity access and how they might use it to change their lives. Households that had enough income to purchase a refrigerator, for example, also decided to open a microbusiness selling carbonated soft drinks.

Kigbe faced similar challenges to those of Igbatoro, such as remote location, poverty, and dependence on a seasonal economy. Yet Kigbe's use of electricity for economic development overcame these challenges to the extent that citizens had enough income to sustain the purchase, and therefore the production, of electricity. We argue that the Kigbe project has promoted the realization of at least four SDGs in the community: health and well-being, clean water and sanitation, affordable clean energy, and climate action. Furthermore, the mini-grid's successful implementation has led to more computer literacy among the younger population, more interest in education, and greater community cohesion. And now that the rural clinic has electricity, it can safely store medicines, benefitting not only Kigbe but surrounding communities.

Insights for policymaking

The very different fates of mini-grids in Igbatoro and Kigbe demonstrate that although modern energy access is an essential condition for achieving the SDGs, the greater energy access challenge is to support interconnected benefits that pull people out of poverty and improve welfare and livelihoods, which enables them to accomplish other goals. Energy systems, in short, should be built to enable economic transformation. Successfully accomplishing that requires not only top-down measures, such as providing capital for grid construction, but bottom-up adoption in communities themselves. Successful energy access projects should meet community needs and goals.

In contrast, the vast majority of energy access programs in the developing world, especially in sub-Saharan Africa, have focused on merely delivering energy that can support a few lightbulbs at the household level; they don't necessarily provide enough energy to support real nonhousehold energy needs. This may be a first step toward providing energy access, but it does not lead to meaningful, sustainable change. The harder part of the project is to get the involvement, consultation, and buy-in of the affected communities.

Government agencies, advocacy groups, international development organizations, nongovernmental organizations, energy suppliers, and financiers should transform their thinking about what is essential for energy access programs. Well-integrated interventions can improve livelihoods for people in low-income communities. And depending on the community's wishes, there are many potential interventions that could turn a failure into a success. In the case of Igbatoro, providing the mini-grid in conjunction with supporting the acquisition of equipment for agro-processing and other productive uses would likely have led to income generation, breaking the vicious cycle of poverty—and enabling the community to support the grid project.

Finally, while solar mini-grids are a start, truly transforming impoverished areas while accomplishing the SDGs will require reliable electricity sources that are significantly larger and capable of powering industry. Governments and utilities should consider revamping existing energy infrastructure while simultaneously building new installations to promote energy access. Some countries with low energy access levels today do not suffer from solely lack of electrical generation, but simply fail to deliver that energy to communities. For instance, Nigeria has about 12 GW of centralized electricity generation capacity, of which only around a third of this capacity is consumed because of a lack of transmission and distribution infrastructure, in part due to a failure to maintain existing infrastructure.

To promote economic empowerment on a larger scale, countries need to upgrade and expand both the generation and transmission systems to perform at their optimum capacity to help deliver on nonhousehold energy needs. In this way, the lessons learned from enabling economic empowerment at the community level should be applied at the state and national level to enable a progressive scaling of not only sustainable energy access but also wider economic empowerment.

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RECOMMENDED READING

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