

THE BOTTOM LINE

The electrification of health centers, schools, and other public institutions has been limited by the slow expansion of national grids, which has staggering consequences for economic growth, poverty reduction, and the accumulation of human capital. Off-grid solar solutions have enormous potential to address the problem, both in Sub-Saharan Africa and across the world, but simply purchasing and installing the units without providing for adequate maintenance is not effective. Installing stand-alone solar units and servicing them through long-term performance-based contracts can give public institutions the electricity service they need at a cost governments can afford.



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Increasing Human Capital by Electrifying Health Centers and Schools through Off-Grid Solar Solutions

How is electrification related to human capital development and poverty reduction?

Access to electricity is essential to the delivery of education and health care

Limited access to electricity imposes significant constraints on the provision of essential public services, such as health care and education, hindering human capital development. Because access to electricity affects productivity and inclusive economic growth, it is a critical stepping stone to ending extreme poverty. Sub-Saharan Africa has the largest energy access deficit, with only 43 percent of the region's population electrified (IRENA 2019). Not surprisingly, it also scores low on the Human Capital Index.¹ Of the 30 countries at the bottom of the index, 25 are in Sub-Saharan Africa.

According to the 2018 Human Capital Index, nearly 60 percent of children born today will be at best half as productive as they could be with access to adequate education and health care. Given that electricity is essential to delivering health care 24 hours a day and ensuring that education of good quality is delivered in this era of digital learning, it is urgent that efforts to increase access to electricity at health centers and schools be intensified. Ultimately, the achievement of the third and fourth Sustainable Development Goals embraced by the member states of the United Nations in 2015—to “ensure healthy lives and promote well-being for all at all ages” (SDG3) and to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (SDG4)—are closely

¹ The index is a summary measure of the amount of human capital that a child born today can expect to acquire by age 18, given the risks of poor health and poor education that prevail in the country where he or she lives.

linked to SDG7: to “ensure access to affordable, reliable, sustainable and modern energy for all.”

World Bank experience reveals a correlation between access to electricity and the productivity of public institutions. Under the Mozambique Energy Development and Access Project, for example, increased access to electricity by health centers was associated with an increase in the number of patients, the quality of services, and the number of services provided. Electricity allowed clinics to test for malaria and human immunodeficiency virus. Electricity in schools was associated with an increase in the number of students, thanks largely to more class sessions, including sessions at night. The introduction of audio-visual equipment increased interest among students. Villagers also benefited from public street lighting, which extended the hours of economic activities after sunset and increased the sense of security (World Bank Implementation Completion and Results Report, 2017).

Why do 1.75 million health centers and schools in Sub-Saharan Africa lack access to electricity—and with what consequences?

The cost of extending the grid to reach remote locations is high—but, ultimately, the cost of continued lack of access to electricity is even higher

Critical public institutions such as health centers, schools, and government offices are at the heart of socioeconomic development in any community. But limited or no access to electricity hampers the efficacy of such institutions, making it difficult for communities

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to develop. Many health centers and schools, particularly in Sub-Saharan Africa, have been waiting for grid electricity for years. But there is no certainty about when—if ever—the grid will be extended, because the cost of extending it to remote locations is high. Cash-crunched governments and utilities find it difficult to justify grid extension in remote areas, where returns are low and the cost of building and maintaining the infrastructure high. In 2013, for example, a health clinic with fans, electric lights, and microscopes was built in Gudupe, Nigeria, in the hope that the grid would be extended. The site still does not have electricity and is not likely to be connected in the next eight years. The health clinic staff use rechargeable and battery-powered flashlights.

According to data gathered by World Bank teams working on Sub-Saharan Africa, about 1.75 million public health centers and schools lack reliable electricity supply. In Ethiopia, for example, only 10 percent of health-care facilities (hospitals, health centers, and health posts) and 28 percent of primary and secondary schools have access to electricity, based on information gathered from Ethiopia's Federal Ministry of Education in 2016 and Federal Ministry of Health in 2018. Similarly, only 26 percent of schools in Senegal and 22 percent of health facilities in Madagascar have access to electricity, according to World Bank teams working in these countries.

Most of these facilities are far from the grid network. The estimated average cost to connect each of them to the national grid is \$2,000–\$5,000. Connecting all unconnected facilities across Sub-Saharan Africa would thus cost more than \$5 billion.

Many Sub-Saharan African countries have launched national electrification strategies that aim for universal access to electricity in 10–15 years. Accomplishing this goal is far from certain, however, in no small part because of the high costs of extending the grid. Even if universal energy access goals could be met in the next 10–15 years, an entire generation of students would be deprived of the health care and education they need *today* for economic and social mobility tomorrow. Addressing their needs now means that solutions other than grid extension must be implemented. Electricity is as critical for holistic outcomes as are medicines and doctors for health facilities and learning materials and teachers for schools.

In Guinea, hundreds of children study at night under streetlights, ignoring car engine exhausts, honking taxis, and rumbling buses. Children gather in publicly illuminated areas to do their homework

because they have no electricity at home or at school. In South Africa, almost 80,000 young children each year unintentionally ingest kerosene (spilled from lamps) to the point where they must be admitted to the hospital; even with treatment, 60 percent of them develop chemically induced pneumonia. In Uganda, children often study in bed with a candle on the edge of their headboards, causing fires and thousands of burn-related accidents, some of which lead to death or lifelong disfigurement (UN DESA 2014). Health workers help women give birth by candlelight, but health-care workers cannot handle emergencies because they lack life-saving machines that require electricity. Governments and other stakeholders must recognize the urgency and consequences of this challenge and devise innovative solutions to electrify 100 percent of health centers and schools.

Are there better ways to electrify public institutions in poor and remote areas?

Off-grid solar is a relatively low-cost energy solution that can be deployed quickly

Technological advancements in stand-alone solar systems have paved the way for electrification of public institutions in remote areas. Thanks to these systems, patients are receiving better health care and students are accessing better education and becoming computer literate. Strong evidence from Kenya, for example, shows that off-grid solar can improve the operations of remote health clinics (Chen, Mwachandi, and Sanyal 2019).

But more resources are needed to install, operate, and maintain stand-alone solar systems. A concerted effort will be required by Sub-Saharan African governments and development partners to ensure access to reliable electricity to health-care facilities and schools. But public agencies alone cannot meet this enormous challenge. Communities need to be made aware of the benefits of electrifying public institutions, so that they value the systems by paying for them to the extent possible and protecting them from vandalism and theft. The private sector, too, must invest in and provide need-based energy solutions. The World Bank has an important role to play in providing data and tools to leverage such investments, to pool financing for off-grid and mini-grid technologies, and, where feasible, to facilitate grid connections to health care facilities and schools.

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What's wrong with the conventional "equipment ownership" model for off-grid electrification?

Too often, the model ignores maintenance

In the equipment ownership model, a government agency makes the up-front investment needed to purchase and install an off-grid system using its own or donor funds; operations and maintenance (O&M) is then either managed by the government agency or outsourced through contracts for a certain period of time. Unfortunately, this approach often fails—as discussed in the three cases below.

In Mozambique, under the Energy Development and Access Project, O&M for health centers and schools was conducted by the implementing agency, FUNAE, the national rural electrification agency. Discussions with FUNAE indicated that the sustainability of such O&M is contingent largely on the receipt of available funding and the deployment of technicians with the right skills and training. Providing O&M is particularly cumbersome in remote areas, which in most cases are hard to reach because of bad road networks. Sometimes an entire day is needed to reach a remote site, delaying repairs and depleting manpower. Technological innovations such as remote monitoring of system performance using cellular network coverage could make O&M less cumbersome.

During a field visit to Niger, a World Bank team learned that, in one location, the government raised funds from several donors to procure three stand-alone solar systems for the same facility over a period of eight years. None of these systems is operational today, because no budgetary allocation was made for O&M. This finding corroborates World Bank data for Sub-Saharan Africa that show that despite sizable capital investment to install solar systems at health clinics and schools, electricity delivery is sometimes nonexistent or substandard.

For the World Bank-funded Uganda Energy for Rural Transformation (ERT-I and ERT-II) projects, five-year O&M contracts were signed by the contractor and the government (in the form of the ministries of health, education, and water). The World Bank

provided finance for the first year of the contract, on the condition that the remaining four years be financed by the implementing agencies. The five-year contract included maintenance visits twice a year (three visits the first year). Each visit entailed cleaning the solar panels, inspecting the batteries and inverters, replacing electric bulbs and fuses, and providing a written maintenance report. The contract also covered several other maintenance requests. The warranty periods for equipment such as inverters and batteries were about three years.

Extension of O&M contracts after the five-year period depended largely on adequate budget allocations. Regrettably, some public institutions treated O&M on an ad hoc basis rather than as a necessity. Some used annual framework contracts after the expiration of the five-year O&M contract. Under the framework contract, the public institutions asked contractors to bid on the cost of providing transportation (per kilometer), supplying/replacing batteries, and performing other maintenance services. Typically, the least-cost bidder was awarded the contract. The scope and value of the contract were dependent on the budget available for maintenance. But health centers in Uganda are offered limited budgets, 20 percent of which are allocated to maintenance of infrastructure, including roads and buildings in addition to energy equipment. Very often the health centers do not receive even this limited budget, limiting the scope of the framework contract.

For the ERT-II project, about 13 percent of solar installations are not functional for health centers and about 30 percent are not functional for schools.² Discussions with authorities revealed that the systems performed well until the five-year O&M contracts expired. Since then, ad hoc framework contracts have been used and securing funding has been difficult, because of the limited budget offered for O&M. These public institutions stated their preference for long-term service contracts, to ensure satisfactory performance over the lifespan of the solar equipment.

² ERT-II electrified 560 schools and 665 health centers between 2010 and 2016. The schools and health centers that were served first have been receiving electricity from solar systems for the past eight years.

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Why are long-term performance-based service models needed?

In the absence of an O&M contract, once the warranty period expires and the system stops functioning, institutions just stop using it, squandering assets

Governments have owned and installed stand-alone solar systems to electrify public institutions for decades. The scale of these initiatives has been determined by the level of funding governments could allocate. But demand for the electrification of public institutions in Sub-Saharan Africa is now so great that government and donor funds are woefully insufficient to address the challenge. Inadequate O&M budgets put at risk the sustainability of those efforts that are funded. What is needed is a model that allows solar systems to be used for their full lifetime.

Long-term performance-based service models address these challenges and reduce sustainability risks significantly. Under this model, the government selects a service provider to provide electricity services to public institutions over a 10- to 15-year period. The service provider is responsible for raising investment capital and ensuring that key performance indicators are met during the contract period. The government pays the provider on a regular basis. This mechanism removes the burden of raising investment capital from the government, which still has to allocate an adequate and consistent budget to ensure that public institutions are able to make regular payments to service providers. Governments can raise funds from the World Bank or other donors to help make these regular payments. Innovative project designs, such as results-based financing and disbursement-linked indicators can support these interventions. Interviews with private sector developers in Niger and Nigeria confirm that the private sector is enthusiastic about participating in these types of business models, provided the payment risks from the government agencies are adequately mitigated.

The service-based business model is not new. Between 2010 and 2017, service-based models electrified about 73 million households containing some 360 million people, assuming an average of five people per household (World Bank Group 2018). An estimated 1.9 million people have used stand-alone solar systems for income-generating productive uses. However, solar companies have avoided

serving public institutions because of the payment risks and administrative hurdles associated with serving government agencies.

The World Bank Group's proposed solution for mitigating the payment risk of government agencies draws on its experience promoting private sector investment in large power plants.³ Since the late 1990s, independent power producers (IPPs) have helped governments reduce their budgetary allocations to fund public power plants, releasing significant public resources for other purposes for which financing from the private sector is not available. IPPs enter into long-term power purchase agreements with public utilities, with governments providing payment guarantees in cases where the utilities lack the necessary creditworthiness. The World Bank Group has used its derisking instruments to improve the credit risk of public utilities, focusing particularly on payment and termination risks. Through the Multilateral Investment Guarantee Agency (MIGA) or the World Bank Guarantee Instrument, the Bank Group can protect investors against governments' failures to honor payment obligations or implementation agreements. With these guarantees in place, the private sector has raised financing for investment and O&M of power plants through long-term electricity service contracts, with the government agencies making monthly payments to the IPPs under PPAs.

The key to successfully raising financing and derisking investment depends on proper risk allocation and the bankability of the documentation. For example, a \$480 million guarantee from the International Bank for Reconstruction and Development (IBRD) helped Argentina unlock its renewable energy potential by creating a market and mobilizing about \$3.2 billion, mostly from private sources. In Nigeria, power generation investors and lenders have traditionally been wary about nonpayment and political risk and hence reluctant to invest in the power sector. To help break this logjam, the World Bank Group supported the Azura-Edo IPP Project, a gas-fired power plant intended to provide electricity to 14 million people. The 459 MW project required about \$900 million in funding, which was provided by 20 equity providers and international banks. Azura was the first

³ The World Bank Group is made up of the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation, the Multilateral Investment Guarantee Agency (MIGA), and the International Center for the Settlement of Investment Disputes (ICSID). Together, IBRD and IDA are referred to as the World Bank.

Table 1. Measures to mitigate risks faced by off-grid solar operators (compared with risks faced by independent power producers)

Locus of risk	Circumstances surrounding the operations of ...		Risk-mitigation measure for off-grid solar operators
	... independent power producers	... off-grid solar operators	
Location	Operations are sharply defined and ring-fenced.	Solar systems for public institutions are spread over large areas; there is no permanent staff to operate the systems.	Recent innovations in digital remote monitoring and mobile money can reduce this risk by providing real-time information on key performance indicators and maintenance requirements of the solar equipment.
Stakeholders	Stakeholders are few and clearly defined, usually including the Ministry of Energy, the Ministry of Finance, and the public utility.	Many stakeholders are involved, including the public institution at which the system is installed (health center, school); its parent ministry; local authorities; the Ministry of Finance; and the community.	<p>Consultations and coordination among multiple stakeholders are critical to make these contractual service agreements successful. Arranging for a central entity to make payments to the private sector can reduce bureaucracy and uncertainty.</p> <p>Contracts should include and protect the interests of all parties. They should include key performance indicators and termination clauses.</p> <p>Involving the community can help ensure that the service is valued. It can increase willingness to pay and encourage vigilant security to protect assets from theft and vandalism.</p>
Accountability	Public utility	May be any of the stakeholders.	Stakeholder consultations determine which government agency signs the contracts and is accountable for payments. Clear delegation of payment responsibilities and community participation are crucial to give the private sector confidence that it will be paid and that its systems will be used and beneficial.
Financial resources for investment (capital and O&M)	Private sector	Private sector	The World Bank Group, other development partners, and governments should discuss and agree on how to support the private sector in raising this investment capital. The government can provide complementary financial support to the private sector in the form of grants, loans, and equity. It can raise funds from donors against results-based financing to ensure regular payment to the private sector, subject to satisfactory performance.
Financial resources for payment of services	Individual consumers paying utility bills	Public institutions (government) and users (students and patients)	<p>The government should allocate funds explicitly through a budget line item for the cost of electricity consumed by public institutions. It should raise funds from donors to support the cost of service instead of raising funds to purchase equipment.</p> <p>It should encourage beneficiaries, such as students and patients, to pay a portion of the service cost.</p> <p>Community representatives, such as parent-teacher associations, should take the initiative to manage the users' share of payments.</p>
Operations and maintenance (O&M)	The private sector is paid on a performance basis and responsible for system performance.	Systems are too often perceived, erroneously, as maintenance free; many are therefore installed and commissioned with no O&M plan. When systems fail to function, they are often abandoned before the end of their useful life.	<p>Long-term (10–15 year) service contracts are preferable to ownership of equipment.</p> <p>Ministries of health and education should provide funding for O&M.</p> <p>Government implementing agencies can tap into federal programs, such as the Decentralized Financing Facility under the Basic Health Care Provision Fund in Nigeria, which provides about \$325 a month to select health facilities in seven states for costs such as O&M.</p>

Long-term performance-based service models reduce sustainability risks significantly. Under this model, the government selects a service provider to provide electricity services to public institutions over a 10- to 15-year period. The service provider is responsible for raising investment capital and ensuring that key performance indicators are met during the contract period.

ROGEP’s goal is to establish a market for the private sector to become a supplier of electricity services rather than a supplier of solar equipment, moving the focus from ownership of equipment to delivery of services.

power generation project in Nigeria to receive guarantee support from IBRD and MIGA and funding from IFC (the International Finance Corporation).

Electrifying public institutions through long-term electricity service contracts for stand-alone solar technology is more challenging than promoting IPPs. Table 1 describes some of these challenges and measures to mitigate them.

What is being done to advance the service-based approach?

The World Bank is testing the approach to bring it into the mainstream

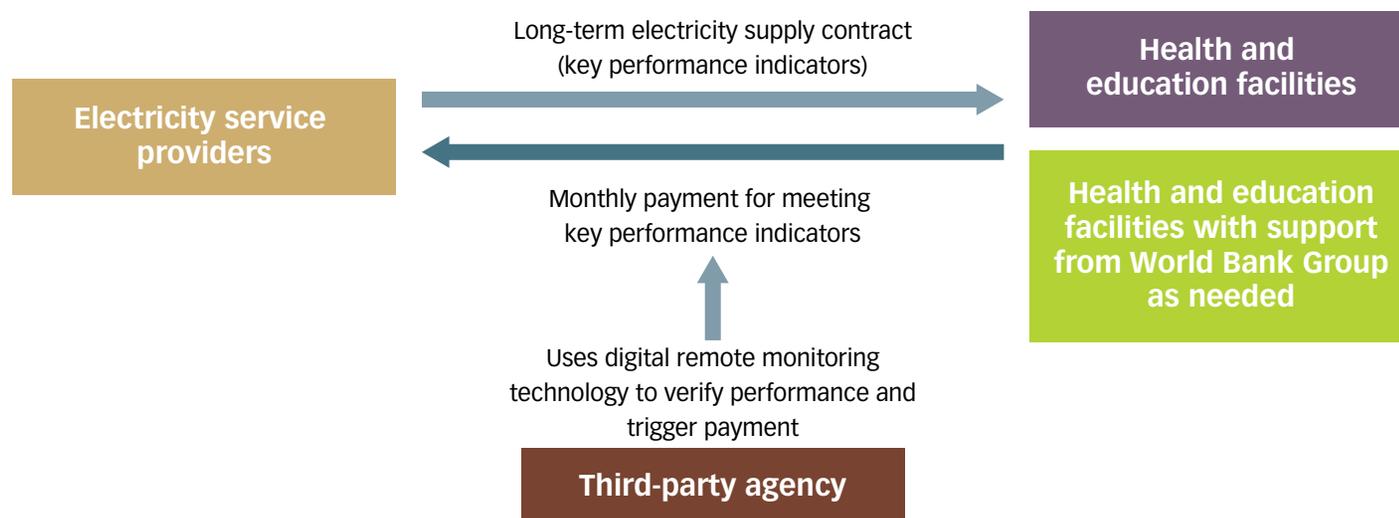
Working with the governments of Niger and Nigeria, the World Bank has launched an effort under the West Africa Regional Off-Grid Electrification Project (ROGEP) to help both countries electrify health and education facilities. The start-up phase, during which about 15 health centers and schools in each country will be electrified, will assess the feasibility of the technological and business model proposed under ROGEP. Lessons learned will be applied to scale up

electrification in Niger, Nigeria, and 17 other countries in West Africa covered by ROGEP.

ROGEP’s goal is to establish a market for the private sector to become a supplier of electricity services rather than a supplier of solar equipment, moving the focus from ownership of equipment to delivery of services. Mechanisms such as guarantees and insurance could be used to reduce the nonpayment risk of the government and instill confidence in the private sector. Such efforts are expected to improve the financing of capital investments, attract more qualified developers, and ensure reliable and cheaper electricity service against timely payment. Multiple private sector companies operating in Niger and Nigeria have expressed keen interest in this approach. The approach is consistent with the Bank Group’s goal of maximizing finance for development.

The aim of the start-up phase is to encourage private companies already providing solar solutions in the two countries to raise financing to procure and install solar photovoltaic systems and then provide long-term (10- to 15-year) O&M service contracts to clinics and schools after they have installed the systems. With the aid of digital remote monitoring (described below and in figure 1) and mutually

Figure 1. Schematic diagram for delivery of electricity service by private sector to public institutions



A concern highlighted during fieldwork is the possibility that international firms may crowd out the local private sector. One possible solution is to ensure that local players are involved in different parts of the business cycle, which may include distribution, routine maintenance, customs, shipping, and consumer relations.

Table 2. Comparison of costs of two ways of financing a hypothetical 5 kW solar electricity system (U.S. dollars)

Item	Costs to government if it pays capital costs up front	Costs to government if service providers raise debt finance
Capital cost		
Procurement and installation cost	30,000	0
O&M and replacement of equipment		
Monthly payment over 20 years	184	
Annual payment over 20 years	2,208	
Monthly payments in first four years		809
Monthly payments in years 5–20		184
Total cost		
Lifetime cost (capital and O&M)	74,160	74,160
Present value cost of proposed solution	46,500	39,300

Note: Estimates assume that the installed cost (including batteries) is \$6 per watt, the annual operating cost is 2.5 percent of the installed cost of the systems, and the discount rate is 12 percent.

agreed performance indicators, the government will pay the private sector monthly to cover their capital and operational expenses. In the start-up phase, the payments will be structured so that the private sector recovers its capital cost in four years.

Quality standards for equipment, design, and installation are combined with digital remote monitoring technology to ensure and verify the performance of off-grid solar systems. By monitoring the performance of the systems against agreed performance indicators, a third party verifies that the service provider is delivering the contractually agreed service and signals the government agency to pay the corresponding fee.

To illustrate the proposed financial structure for the start-up phase, table 2 compares a payment structure in which the capital cost is paid up front by the government agency (through its own funds or donor funds) with one in which service providers raise debt finance to cover the capital cost. It shows that the lifetime present-value cost to the government of a 5 kW solar system is

15 percent lower when service providers raise the finance needed to procure, install, operate, and maintain the equipment. Spreading the cost of the systems over many years and keeping service providers engaged is expected to reduce up-front capital costs for government agencies and improve the long-term performance of systems.

Lessons from this start-up phase will be used to help scale up the electrification of public institutions by designing risk-mitigation schemes that allow the private sector to invest in electricity service provision. By virtually eliminating initial capital costs and spreading the financial burden of these systems over time, such a structure will enable governments to provide reliable electricity services to rural health clinics and schools at a much faster rate than might otherwise be feasible. Scaling up the program in countries should also allow providers to lower their prices, as a result of economies of scale associated with larger volume.

What challenges confront this new approach?

Fieldwork suggests some ways to ease the budget constraints of public institutions and to reassure potential private providers of off-grid solar systems

Fieldwork and discussions in Nigeria revealed that almost all public facilities are largely responsible for paying the O&M costs associated with electricity but that few have the resources to do so. The health clinics surveyed were responsible for their own utility and maintenance bills; school development committees and parent-teacher associations often helped foot utility and maintenance bills at schools. Monthly available revenues to the facility, including utility payments and site maintenance, averaged \$126, while their reported willingness to pay for the operation and maintenance of a solar electricity system averaged \$14 a month. Only large boarding schools and clinics were willing to pay more than \$14 a month. However, their ability or willingness to pay was linked to the cost they currently incur for the limited electricity service they receive. Thus, for this scheme to be sustainable, funding support from other sources will be needed to cover monthly costs, given the low willingness to pay for O&M of solar systems at public institutions. There is a clear need to investigate options for financial support from other sources, such

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as federal or state governments or outside funds, so as to ensure the long-term viability of the framework.

In a recent mission to Nigeria, the ROGEP team learned that the federal ministry directly allocates about ₦100,000 (\$327) a month to some primary health centers in seven states through the Decentralized Financing Facility under the Basic Health Care Provision Fund. This allocated budget is sufficient to pay the monthly O&M costs to the private sector under the ROGEP service-delivery model. Niger has a fund managed by the World Bank in which many donors place their resources for health care provision; the Ministry of Health determines how these resources are to be used. If governments, donors, and implementing agencies agree, the fund could be used to pay the capital and O&M costs of off-grid systems installed by private providers. Similar funds in the Ministry of Education could also be tapped. The sale of electricity for productive uses (gardening, photocopying) could help generate additional revenue to cover O&M costs.

As previously noted, lack of trust that the government will make timely payments makes the private sector reluctant to provide services. Financing support from institutions such as the World Bank may provide comfort to private providers, but there is uncertainty about how effective such support would be. The private sector is fearful of reputational damage if it disconnects a health center for nonpayment. Hence, it is important to set the right expectations regarding terms and timeline of payments and associated risk-mitigation measures. Contracts must protect the interests of all parties and mitigate the risk of change of government, which often leads to changes in policies and priorities.

Another concern highlighted during fieldwork is the possibility of international firms crowding out the local private sector. Several local firms remarked that foreign companies can secure financing at low rates from their home countries, leaving little room for competition by local players. The high cost of financing (more than 20 percent a year) in many Sub-Saharan Africa countries typically does not allow businesses to serve rural public institutions viably. One possible solution is to ensure that local players are involved in different parts of the business cycle, which may include distribution, routine maintenance, customs, shipping, and consumer relations. Business models should promote partnerships between local and foreign private companies to provide the best possible sustainable solutions to consumers.

Private sector firms are also concerned about what happens to stand-alone systems if the grid is extended. Accordingly, it is important to select health centers and schools that are likely to use a stand-alone system for a long enough period for firms to recoup their investment. The long-term service contract must set mutually agreeable terms for termination of the contract to mitigate the risk of the grid reaching a public facility served by a private company under the service contract.

How can the World Bank help to scale up energy access to public institutions?

Several success criteria have emerged from work to date

Electrification of health centers, schools, and other public institutions has been limited by the slow pace at which national grid networks are being extended to connect them. Off-grid solutions have enormous potential to shape their future—in Sub-Saharan Africa and across the world.

Innovations in technology and new business models can provide reliable electricity service to public institutions through long-term service contracts with the private sector. The World Bank is currently promoting such contracts through its projects in Niger, Nigeria, and Uganda, and it aims to use similar models to electrify health centers and schools in other countries. Staff have also peer-reviewed reports on this subject and spoken at global conferences highlighting the importance of this topic.

Several recommendations for scaling up energy access to public institutions emerge from this work:

- The World Bank Group and its partners should identify mechanisms for fostering a service-delivery ecosystem that will allow the private sector to invest in and serve health centers and schools with reliable electricity supply. The focus must be on delivery of electricity service rather than ownership of equipment. Maintaining systems over the lifetime of the project is critical.
- Contracts should protect the interests of all parties involved (public institutions, private company, community stakeholders) by setting key performance indicators and termination clauses. To

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garner the trust of the private sector, measures for the mitigation of payment risk should be less bureaucratic, and the terms of payment must be clear. Third-party verification agencies should be employed to resolve payment disputes.

- The long-term contractual framework should be designed to survive possible policy changes associated with changes in government over the contract period.
- Strong coordination is needed with multiple government agencies to ensure that financial resources help cover capital and O&M costs for public institutions.
- Public institutions should be allowed to use electricity for some income-generating activities. For example, schools can be used as centers for computer education or venues for functions during summer vacation, evenings, and weekends. Selling these services would generate revenue for O&M.
- Communities (e.g., parent-teacher associations) are critical to the sustainability of any project. Raising awareness of the value of electricity services is likely to increase communities' willingness to pay for services and protect solar system assets from vandalism and theft.
- Better coordination among sectors within both government and donor agencies will help identify and implement sustainable solutions.

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