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FOREWORD

Recent estimates presented in the 2017 version of the Global Tracking Framework established by the international initiative known as Sustainable Energy for All (World Bank and IEA 2017) show that roughly a billion of the world's people still live without access to electricity. Over half of these people are estimated to live in Sub-Saharan Africa, with approximately 482 million living in rural areas and another 105 million in urban. In order to achieve the UN Sustainable Development Goal #7, which focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all by 2030, an estimated $49 billion per year will have to be invested in extending electricity.

Public funds alone are insufficient to meet this daunting challenge. Various approaches to increasing the flow of private investment to rural electrification have been attempted, but consistent and replicable success remains elusive.

Electricity "concessions" represent one of those approaches. A concession is a form of public-private partnership in which the private sector is granted the right to build, operate, and expand public infrastructure for a predefined period of time. Although electricity concessions have been used most prominently to attract private investors to improve the operational efficiency of national utilities and distribution networks, they also have been applied to mini-grids, solar home systems, and even previously unelectrified zones.

This report presents a review of the experience of Sub-Saharan African countries in deploying concessions to increase both the level of electrification and the level of private investment in rural electrification from the 1990s until the present. The results have been mixed. In several cases, concessions have proven successful at increasing access to electricity. In others, evidence indicates that the effect of electricity concessions on the pace of electrification has been minimal. In yet another set of instances, the concession proved unprofitable or unworkable, and the model was abandoned.

Regardless of whether the concession approach to rural electrification is a promising solution (and the authors believe that, under certain conditions, concessions can deliver results), this report presents a first-of-its kind summary and inquiry into the use of these public-private partnerships for enhancing rural access to electricity in the region. By learning from experience, we can find effective ways to meet the formidable and urgent challenge of universal access to electricity in Sub-Saharan Africa.

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EXECUTIVE SUMMARY

To extend the educational, economic, and health-related benefits of electricity to more people, African governments are working to increase the scale and pace of rural electrification, often in partnership with international donors guided by the international Sustainable Energy for All (SE4All) Initiative. SE4All, a partnership of the United Nations, the World Bank, and the International Energy Agency, has drawn the attention of the international community to the more than 1.1 billion people around the world now living without access to modern energy sources. Of these people, roughly 630 million live in Sub-Saharan Africa, where the overall rate of access to electricity is just 35 percent; the rural rate is considerably lower (World Bank and IEA 2015). In several countries, fewer than 20 percent of rural dwellers have access to electricity in their homes. At its founding in 2013, SE4All announced the goal of achieving universal access to electricity by 2030.

Progress toward universal electricity access has been slow in Sub-Saharan Africa, with a few notable exceptions. Between 2000 and 2012, only 14 of the 49 countries in the region increased electricity connections at a rate faster than 1 percent per year (World Bank and IEA 2015). In most places, population growth continues to outpace electricity access growth. At current levels of progress, more than 50 years will be required for the subcontinent to achieve universal access.

As national power utilities in most African countries have struggled to extend the power grid beyond urban areas, interest has grown in alternative institutional and business models to speed electrification. And because the investments required by the power sector are so great, increased attention has been paid to attracting funds from the private sector. Well-structured public-private partnerships (PPPs) can bring private resources to bear on challenges such as rural electrification.

Concessions—agreements in which the government grants a private company the right to extend a specific service under conditions of significant market power—are one of many forms of private sector engagement in infrastructure. Several African countries have already awarded concessions in the power sector, and their experience is the subject of this study. Many more have considered but chosen not to implement concessions, sometimes after an initial unsuccessful experience.

The record of concession arrangements in stimulating faster and more effective rural electrification in Sub-Saharan Africa is mixed. Although no case has brought universally heralded success, it is possible to distinguish certain characteristics, approaches, and conditions that may improve the effectiveness of future concessions. Those lessons, coupled with technological advances that can make concessions

more attractive to the private sector, can make future concessions a powerful tool in the fight for universal access to electricity.

The fundamental challenge of rural electrification undertaken through concessions and other PPPs is that rural electrification is not profitable within the time frames normally considered attractive to the private sector. Partly for reasons of affordability and partly because they lack electrical appliances and other devices, rural consumers initially consume only small amounts of electricity, frequently falling within the subsidized segment of the tariff structure often referred to as the "lifeline" tariff, which does not begin to meet the capital costs of establishing new connections and supplying electricity in rural areas. Thus, rural electrification must be viewed as a long-term investment in social welfare.

These characteristics of the rural electricity market in developing countries limit the scope of concession arrangements and the potential of private sector participation. Because rural electrification has usually been inconsistent with the investment requirements of private investors, many concessionaires demand public grants or cost-sharing to meet the financing gap associated with building and operating new rural electrification lines. But as small-scale renewable energy technologies become a common part of the electrification tool kit, so does the potential to reduce the capital costs of electrification and quicken its payback period. The maturation of geographic information systems (GIS) also promises to elicit greater interest from private parties by lowering various risks.

This report evaluates the use of rural electrification concessions in Africa. It provides a comprehensive overview of successful and failed cases and identifies the likely factors behind successes.

The research was conducted in three stages. First, a detailed desk review of rural electric concessions in Africa was undertaken to understand the landscape of concessions. Next, six in-depth, field-based country case studies were prepared.[1] Finally, a limited desk review of the experiences with concessions and concession-like structures in both Asia and Latin America was carried out in order to provide a point of comparison for the African experience.

This report is aimed at two primary audiences: World Bank energy and infrastructure practitioners, who often receive queries from clients about the potential benefits and challenges of using concessions for rural electrification, and governments in Sub-Saharan Africa and beyond that are considering using the concession approach to address the challenge of rural electrification.

Understanding concessions

A "concession" is "any arrangement in which a firm obtains from the government the right to provide a particular service under conditions of significant market power. A concession is thus a device that can be used to create competition for a market, when competition in the market is not operating" (Kerf and others 1998).

Concessions may be better understood when located along the continuum of PPP

arrangements in the provision of infrastructure services. Options along that continuum vary based on the allocation of risks and responsibilities—from pure public to pure private ownership and operation (Guislain and Kerf 1995). The most elementary forms of private sector engagement come in the form of contracts with public owner/operators to provide supplies, civil works, technical assistance, or management services. But even management contractors take little or no operating risk and are paid a fee for providing services (frequently linked with performance-based incentives).

The level of private sector engagement increases under concessions. Here, the private contractor assumes risk in anticipation of a return. Leasing (widely referred to using the French term *affermage*) represents a type of PPP in which the public sector retains ownership of the assets as well as responsibility for making new investments and expanding the asset base. The private partner assumes responsibility for operating and maintaining the assets, providing the public service, and collecting payments for it. In exchange for the right to collect payments, the concessionaire makes regular lease payments to the asset owner.

Strict concessions, as opposed to leases, require the private lessor to operate, maintain, and expand the asset in accordance with carefully negotiated and specified terms. The lessor must return the asset, with all improvements, to the owner at the end of the concession period. Both build-operate-transfer concessions for greenfield (new) interventions and rehabilitate-operate-transfer concessions for brownfield (rehabilitated) interventions fall into this category.

The highest degrees of private sector involvement (where a private entity is selected to build, own, and operate an asset under contract with the public sector or where the public sector divests itself entirely of an asset) are not dealt with in this report.

A detailed review undertaken for this study identified nearly 200 electricity concessions. Many are small operations connecting to as few as a hundred customers. Others are national utility concessions that focus less on providing service to previously nonelectrified rural households than on improving the technical and financial management of the electricity sector as a whole.

About 15 African countries host one or more active concessions of four types, all following the lease (*affermage*) or strict concession model (table ES.1). Another six countries adopted electrification concessions at some point in the past 25 years but later abandoned them. Still another six or seven countries gave serious consideration to adopting a form of concession before abandoning the idea.

Mini-grid concessions have shown themselves to be successful at engaging local investors and increasing the number of rural customers served. However, in none of the six cases studied have these arrangements attracted large international investors or resulted in a rapid increase in overall national electrification. As policy makers and international donors turn to mini-grids as a cost-effective way to

Table ES.1. Four types of rural electrification concessions

Concession type	Scale (number of connections)	Demographic of clientele	Power source	Electrification technology	Type of asset
Mini-grid concessions	100–10,000 customers	Rural	Small integrated generation and distribution networks (in some instances operated as localized distribution utilities selling power from the national grid)	Mini-grids	Greenfield or brownfield
Solar home system concessions	Solar home systems can electrify one household at a time, sometimes more, and concessions can service 5,000–30,000 such systems	Rural	Solar home system	Isolated solar home systems	Greenfield
Rural zonal concessions	As conceived, 5,000–30,000 to begin, with the intent that they could grow beyond that size	Rural	Various: large, centralized power stations, small isolated generators, or solar home systems	Grid extension, mini-grids, and isolated solar home systems	Greenfield or brownfield
National utility concessions	100,000 or more	Mostly urban, partly rural	Large, centralized power stations	Grid extension and occasionally, mini-grids	Brownfield

Note: In a greenfield concession, a private entity builds and operates a new facility. In a brownfield concession, a private entity takes over an existing facility or asset, which is usually government-owned.

expand access to electricity, it becomes increasingly important to ensure that mini-grid concessions are designed and implemented properly, as discussed further on.

Concessions of solar home systems have so far been tried only in South Africa, and the model is being gradually abandoned. Given the absence of natural monopolies in the supply of solar home systems and the rapid and serendipitous innovations in solar technology, this model holds little promise for future replication. Solar home systems surely will play an increasing role in rural energy provision. But, based on the South African case, this will occur outside the bounds of a concession framework.

Rural zonal concessions have been undertaken only in Senegal, where progress has been slow. While the concessions continue to function, one of their biggest drawbacks has been the time needed to design and implement the model. Work on the program began in 2004, and by the end of 2015 only 3,760 connections had been provided, with approximately two-thirds of them made through solar home systems. While conceptually appealing, the Senegalese experience is not an attractive model for

any countries considering the zonal concession approach.

National utility concessions have been successfully implemented in four countries (Cameroon, Côte d'Ivoire, Gabon, and Uganda) and have all been effective at increasing the density of electrification. The primary aim of such concessions has been to improve utility performance, and rural electrification has not been one of their primary objectives. But when governments have encouraged such concessions to contribute to help expand access to electricity, they have responded favorably and with positive results. Although the number of national utility concessions across Africa is not growing at the present time, the success that several countries have had in using them to expand access in rural areas should be borne in mind by other countries.

Table ES.2. Improved Access to Electricity in Sub-Saharan Africa, 2000–12: Twelve Fastest Growing and Those with Concessions

Access growth rank (#)	Country	2000		2012		Changes between 2000 and 2012		2012
		Population	National electrification rate (percent)	Population	National electrification rate (percent)	Increase in the national electrification rate (percent)	Average annual percentage growth in electrification rate	Annual population growth rate (percent)
1	Senegal*	9,860,578	37	13,780,108	57	20	1.67	3.12
2	South Africa*	44,000,000	66	52,341,695	85	19	1.58	1.55
3	Ghana	18,824,994	45	25,544,565	64	19	1.58	2.44
4	Gabon*	1,231,548	74	1,613,489	89	16	1.33	2.27
5	Lesotho	1,856,225	5	2,057,331	21	16	1.33	1.19
6	Togo*	4,874,735	17	6,745,581	31	14	1.17	2.70
7	Ethiopia	66,443,603	13	92,191,211	27	14	1.17	2.56
8	Botswana	1,736,579	40	2,132,822	53	14	1.17	2.04
9	Mozambique	18,264,536	7	25,732,928	20	13	1.08	2.82
10	Benin	6,949,366	25	10,049,792	38	13	1.08	2.73
11	Cabo Verde*	438,737	59	500,870	71	12	1.00	1.15
12	Rwanda	8,021,875	6	10,817,350	18	12	1.00	2.44
20	Uganda*	23,757,636	9	35,400,620	18	10	0.83	3.27
22	Mali*	11,046,926	17	16,112,333	26	9	0.75	2.98
26	Cameroon*	15,927,713	46	21,659,488	54	8	0.67	2.53
43	Madagascar*	15,744,811	11	22,293,720	15	4	0.33	2.80

Source: World Bank and IEA (2015).

*These countries had a concession in place during part of the period from 2000–12. The concessions in Togo and Cabo Verde were terminated in 2006.

Concessions and growth in access to electricity

Our review of concessions in Africa surveyed advances in rural electrification under the concessions. To place that information in context, table ES.2 provides information about the changes in electrification in the 12 most rapidly electrifying countries in Sub-Saharan Africa (including two of the case-study countries, Senegal and South Africa), supplemented by the same numbers (and ranks) for the four remaining case-study countries. The astericked countries had some form of concession in place for the years from 2000 to 2012, although the concessions in Togo and Cabo Verde were terminated in 2006.

Of the top 12 countries, three had concessions still in place by 2015: Senegal, South Africa and Gabon. In neither Senegal nor South Africa can the relatively rapid increase in electrification be attributed to the concessions. Rather, in each of these instances, the national utility (SENELEC and Eskom, respectively) was responsible for the rapid increase in electricity connections, with the concessions playing only a very small role in this growth. For Gabon, the government and the concessionaire cooperated to increase access, but it was still outpaced by population growth.

For the other case-study countries—Uganda, Mali, Cameroon, and Madagascar—the concession programs did not result in a rate of electrification growth increase of even 1 percent per year.

Table ES.3. Sub-Saharan African countries with mini-grid concessions

Country	Mini-grid program name	Years in operation	Number of mini-grid concessionaires and mini-grids in operation	Total number of connections made through mini-grid concessions	Average number of connections per mini-grid
Burkina Faso	Electricity Cooperatives (Coopels)	2003–present	Concessionaires = 92 Mini-grids = 92	14,250	155
Guinea	Decentralized Rural Electrification (PERD) Project	2006–present	Concessionaires = 26 Mini-grids = 26	8,248	317
Madagascar	Mini-grid concessions	2005–present	Concessionaires = 30 Mini-grids = 30[a]	7,100	237
Mali	Projets de Candidatures Spontanées d'Electrification Rurale (PCASER)	2003–present	Concessionaires = 68 Mini-grids = 250	78,000	312
Senegal	Projets d'Electrification Rurale d'Initiative Locale (ERIL)	2003–present	Concessionaires = 4 Mini-grids = 4	500	125
Uganda	West Nile Rural Electrification Project	2003–present	Concessionaires = 1 Mini-grids = 1	6,800	6,800
	Small grid extension concessions	2006–present	Concessionaires = 5 Mini-grids = 5	31,600	6,320

a. In Madagascar, 200 villages are provided with service by the remaining 30 operators, but the exact number of mini-grids is not known (some mini-grids serve multiple villages).

Mini-grid concessions

The study examined six countries—Burkina Faso, Guinea, Madagascar, Mali, Senegal, and Uganda—in which mini-grid concessions were still in operation in late 2015 (table ES.3).

In all cases, the concessions were established under a program initiated by the country's rural energy agency or fund, which shouldered some or all of the capital costs of the system. These programs elicited participation from local entrepreneurs possessing the knowledge and resources to operate a mini-grid system. But because they did not have access to large pools of equity and debt investment capital, they required financial support from their respective governments to meet the capital costs of building the system.

Mini-grid concessions have increased the number of rural electricity customers in the countries in which they have been established and unleashed local entrepreneurs and enterprises, creating an avenue for local investment and for the bottom-up emergence of small electricity networks in rural areas. Mali may have implemented the most successful mini-grid program to date, one that has resulted in more than 70,000 people gaining access to electricity.

Typical cost breakdowns between public and private cost-sharing range from 60 percent to 80 percent public funding. But when the point of comparison is rural electrification projects with 100 percent public funding, these concessions have demonstrated that private financing and expertise can indeed be brought to bear.

Two developments are likely to help mini-grid concessions work better in the future. First, the shift from reliance on diesel fuel to renewable energy promises to lower mini-grids' operational costs. Second, new technology—such as pay-as-you-go, smart meters, and remote control—should improve their financial viability. Rapid technological innovation can quickly make unattractive installations more attractive and sustainable.

Experience to date has brought to the forefront several areas in which future mini-grid concession arrangements can be improved over those reviewed in this study. In brief, future mini-grid concessions will need to become more attractive and susceptible to private financing. They should benefit from significant and well-tuned subsidies. They should be permitted to offer tariffs that promote financial viability. They should operate in accordance with a plan either to reach utility scale and scope (for example, by being encouraged to operate several mini-grids) or to be connected to the national grid.

National utility concessions

The study reviews all four national electrical utility concessions operating in Sub-Saharan Africa at the end of 2015: ENEO in Cameroon, CIE in Côte d'Ivoire, SEEG in Gabon, and Umeme in Uganda. The first three firms operate as vertically integrated electric utilities, whereas Umeme is purely a distribution utility with no responsibility for generation or transmission in

Uganda's unbundled electricity sector.[2] All four concessions have met the objectives of improving sector performance and maintaining fiscal sustainability.

None of these concessions was established with a primary objective of increasing rural access to electricity, but three of the four concessions have shown an ability to increase access to electricity within the concessionaire's designated service areas. In Cameroon, ENEO (and its predecessors) have added an average of about 40,000 connections per year and succeeded in raising the number of grid connections by 570,000, of which 190,000 are in rural areas. In Gabon, SEEG has added roughly 10,000 new connections per year, raising the national access rate to 89 percent and the rural access rate to 45 percent. Umeme averaged 30,000 new connections annually from 2005 to 2014, peaking with 78,000 new connections made in the final year of this period. Altogether Umeme has increased connections by a total of 360,000, of which roughly 120,000 are in the rural areas. CIE is the only one of the four utility concessions that has not yet achieved significant increases in rural access.

The challenge now is to reach agreements whereby the strengths of the concessions are brought to bear on expanding rural access without compromising the primary goal of improving utility performance. Perhaps the simplest way to do this would be to negotiate a set of agreements related to rural electrification within the overall concession framework. This could include cost-sharing arrangements between the government and concessionaires or government guarantees of loans to the concessionaires for grid extensions not expected to contribute immediately to the health of the concessionaire's short-term balance sheet. Such arrangements might be the most direct way of harnessing the financial strength of relatively large actors to play a greater role in expanding access to electricity in rural areas.

Conditions for successful concessions

Concessions are conceived, designed, and implemented within the context of a country's power sector, and that context is crucial in determining their success. Particularly important is commitment on the part of the government and major power sector institutions to enable concessions to succeed. Building on that commitment, the context for concessions must meet certain key conditions, both financial and regulatory.

Financial viability. As noted, investments in large-scale expansion of the grid to rural areas generate economic benefits over the long-term, but for the most part they are not financially viable in the short to medium term. The public sector, therefore, typically bears the capital expenditures required to connect rural consumers. Concessionaires, meanwhile, expect to earn a sufficient positive rate of return on their investment and for the assumption of various risks.

Over the duration of the concession, the government and regulatory environment must ensure a balance between the adequate financial returns for the concessionaire and socioeconomic objectives such as affordability and inclusiveness. This requires a combination of subsidies and well-designed tariff regime.

Pre-investment support. The pre-investment period—when a private firm is considering becoming a concessionaire—requires active support and engagement on the part of the public sector. Regulators (or relevant government authorities) should formulate a comprehensive investment prospectus based on high-quality sector data to assist prospective concessionaires in making informed decisions. Government authorities also should assume some of the costs of gathering information useful for prospective concessionaires in meeting their due-diligence responsibilities and should provide timely responses to requests from concessionaires for additional data and information.

Clarity as to mutual rights and responsibilities. The roles of power sector entities that interact with or affect the concession should be defined distinctly and transparently. Uncertainties, conflicts, and failure to adhere to commitments can discourage investment. This cuts both ways, of course. A concession can work as a partnership between private and public parties only when the rights and responsibilities of each are clearly defined, agreed upon, and adhered to. Provision of this condition largely depends on the existence of an adequate overall regulatory and legal framework—one that encompasses public-private partnership laws or a dedicated Law on Concessions—in which the respective concession regime would be embedded.

Detailed contracts with built-in flexibility. Legally binding contracts should comprehensively define the rules of the game and key operating parameters. Regulatory or legal processes for changing contractually defined terms and parameters in response to evolving economic, technological, or legal conditions should also be clearly defined. Protecting contracts from unexpected or arbitrary changes will improve concessionaires' willingness to invest, while the possibility of renegotiation under specified conditions enables mutually agreeable and optimal adaptation to new circumstances.

Reasonable costs of compliance. The costs of compliance should be reasonably matched to the nature and size of the concessions being implemented.

Timely payments and predictable cash flows. Public sector payments to the concessionaire in the form of initial capital-cost subsidies, recurrent subsidies, or reimbursements must be adequately budgeted and disbursed in a timely manner. Large or repeated deviations from expected cash flows will sap the confidence of private partners and discourage further investment.

The future of concessions for rural electrification

This report has reviewed electricity concession arrangements in Sub-Saharan Africa during a period when electrification lagged behind population growth. As African populations, governments, and the international community place greater emphasis on universal electrification, the pressure will grow to find ways to tap private investment and expertise to meet the challenge—notably through mini-grids and specialized adaptations to national utility concessions.

Properly conceived concessions provide a legal structure for effective public-private-partnerships in the electricity sector. Of course, they do not alter the fundamental economics of rural electrification or reduce overall costs; rather, they provide opportunities to bring private resources to bear. What should be clearly understood is that concession arrangements are not an end in themselves, but a means to provide incentives and protections that can attract private resources and expertise to the challenge of accelerating electrification in rural Africa.

Advances in electrification planning made possible by GIS technology will allow future mini-grid concessions to yield greater economies of scope and cost-recovery tariffs. Simultaneous advances in renewable energy technology—especially solar photovoltaics—already have multiplied the options for generating power in rural areas.

Through the use of GIS-based planning, through the use of stand-alone solar home systems (likely under conditions of competition rather than concession), and through cost-reducing hybridization of mini-grid generation, rural electrification is evolving rapidly, making it easier to plan and manage successful concessions. When sufficiently supported by the interested government, properly incentivized, and placed within an appropriate legal framework, concessions can be a useful tool for attracting private resources, managerial expertise, and technical know-how to address the enormous rural electrification challenge.

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ACRONYMS AND ABBREVIATIONS

ADER	agency for the development of rural electrification (Madagascar)
AER	Agence d'Electrification Rurale
AMADER	Agence Malienne pour le Développement de l'Energie Domestique et de l'Electrification Rurale
ARSEL	Agence de Régulation du Secteur de l'Electricité du Cameroun
ASER	Agence Sénégalaise d'Electrification Rurale
AU	administrative unit
BOT	build-operate-transfer
BOO	build-own-operate
CIE	Compagnie Ivorienne d'Electricité
CRSE	Commission de Régulation du Secteur de l'Electricité
EdF	Electricité de France
ENEO	national electrical utility company of Cameroon
Eskom	national electrical utility company of South Africa
ERIL	Electrification Rurale d'Initiative Locale du Sénégal
FDE	Fonds de Développement de l'Electrification de Burkina Faso
FERD	Fonds pour l'Electrification Rurale Décentralisée
GIS	geographic information systems
IPP	independent power project
JIRAMA	national electrical utility company of Madagascar
ONEE	Office National de l'Electricité et de l'Eau Potable du Maroc
PCASER	Projets de Candidatures Spontanées d'Electrification Rurale
PERMER	Proyecto de Energías Renovables en Mercados Rurales
PPER	Programmes Prioritiaires d'Electrification Rurale
PPP	public-private partnership
RERED	Renewable Energy for Rural Economic Development
ROT	Rehabilitate-Operate-Transfer
SEEG	Société d'Énergie et d'Eau du Gabon
SENELEC	Société Nationale d'Électricité du Sénégal
SE4ALL	Sustainable Energy for All
SONABEL	Société Nationale d'Électricité du Burkina Faso
SONEL	Société Nationale d'Electricité du Cameroun
STEG	Société Tunisienne de l'Electricité et du Gaz
Umeme	private concessionaire operating main national distribution network in Uganda
UEDCL	Uganda Electricity Distribution Company Limited
WENRECO	West Nile Rural Electrification Company

All references to dollars refer to U.S. dollars ($) unless otherwise indicated.

Chapter 1. INTRODUCTION

Private sector participation in rural electrification in Africa

The Sustainable Energy for All (SE4All) initiative, representing a partnership of the United Nations, the World Bank, and the International Energy Agency, has drawn the attention of the international community to the more than 1.1 billion people around the world now living without access to modern energy sources. Of these people, roughly 630 million live in Sub-Saharan Africa, where the overall rate of access to electricity is just 35 percent; the rural rate is considerably lower (World Bank and IEA 2015). At its founding in 2013, SE4All announced the goal of achieving universal access to electricity by 2030.

Progress toward universal electricity access has been slow in Sub-Saharan Africa, with a few notable exceptions. Between 2000 and 2012, only 14 of the 49 countries in Sub-Saharan Africa increased electricity connections at an annual rate of at least 1 percent (World Bank and IEA 2015). In most places, population growth continues to outpace growth in access to electricity. At current levels of progress, more than 50 years will be required for the subcontinent to achieve universal access.

The financial costs of providing universal access are daunting. In 2015, a total of $9 billion was invested in increasing access to electricity in developing countries, against the $45 billion estimated to be needed to achieve SE4All's goal of universal access by 2030 (SE4All Advisory Board's Finance Committee 2015). As Sub-Saharan Africa is host to 19 of the 20 countries with the lowest electrification rates and 14 of the 20 countries with the highest absolute electricity access deficits, achieving universal access in Africa will require special focus (World Bank and IEA 2015: 48). Because no single solution with universal appeal or effectiveness has been identified to simplify and accelerate the expensive and time-consuming process of rural electrification across the vast continent, future efforts will have to draw upon successful models wherever they can be found.

Annual investments to increase electricity access currently amount to just a fifth of what is required to achieve universal access by 2030. What can be done to increase them investments and to improve their effectiveness? A common answer is to bridge the financing gap by leveraging the resources of the private sector. The SE4All Advisory Board's Finance Committee made linkages to the private sector the focus of its 2015 report (SE4All Advisory Board's Finance Committee 2015). However, because rural electrification investments are rarely profitable in the short-run,

they are generally unattractive to most private investors unless they can be blended or supplemented with resources from the public sector.[3]

Independent power projects (IPPs) are the most common form of private engagement on the generation side of the power sector in Sub-Saharan Africa. A recent World Bank study (Eberhard and others 2016) notes:

> Historically, most private sector finance has been channeled through privately financed independent power projects (IPP), supported by nonrecourse or limited recourse loans, with long-term power purchase agreements with the state utility or another off-taker. Between 1990 and 2014, IPPs have spread across Sub-Saharan Africa and are now present in 17 countries. Currently, there are 125 IPPs, with an overall installed capacity of 10.7 GW and investments of $24.6 billion. However, private investment could be much greater and less concentrated. South Africa alone accounts for 67 IPPs, 4.3 GW of capacity and $14.4 billion of investments; the remaining projects are concentrated in a handful of countries.

As with IPPs on the generation side, public-private partnerships (PPPs) on the distribution side can be used to bring private sector capital and expertise to accelerate universal electricity access. If structured properly and offering appropriate incentives, PPPs can enlist private resources to supplement public resources, thereby increasing the pool of capital available to meet the electrification challenge.

Electricity concessions are one form of PPP that has been tried in various forms in several countries in Africa and elsewhere. This report provides a review and analysis of such concessions in order to understand the extent to which they can improve the pace, effectiveness, and sustainability of rural electrification in Sub-Saharan Africa.

Defining concessions

The term concession is broadly used to refer to "any arrangement in which a firm obtains from the government the right to provide a particular service under conditions of significant market power. A concession is thus a device that can be used to "create competition *for* a market, when competition *in* the market is not operating" (Kerf and others 1998).

Concessions have been used in Europe for centuries to provide incentives for the private sector to operate, maintain, and even expand upon infrastructure investments that remain publicly owned (see, for example, Bousquet and Fayard 2001). Their use is more common under legal systems shaped by the tradition of civil law (the continental European or French tradition), which is highly codified and rooted in reliance on existing robust regulations and statutes; judges have a more limited role of applying the law to the case in hand rather than acting as arbiters between parties that present their arguments, as is the norm in the common law approach (British tradition). In the European tradition, concessionaires assume operational risks, maintenance obligations, and often investment responsibilities for the concessioned asset over an agreed period, but the public sector retains ownership. A concession contract spells out the private

concessionaire's right to operate the publicly-owned asset under an agreed-upon regulatory regime (Bakovic, Tenenbaum, and Woolf 2008). In the British tradition, the focus has been more on property rights, with the tendency being to divest the public sector of assets, leaving the private sector to assume full responsibility for those assets subject to regulatory oversight.

Concessions may be better understood when placed within the spectrum of PPP arrangements in the provision of infrastructure services. Options along the continuum vary based on the allocation of risks and responsibilities—from pure public to pure private ownership and operation, as seen in figure 1.1. (Guislain and Kerf 1995).

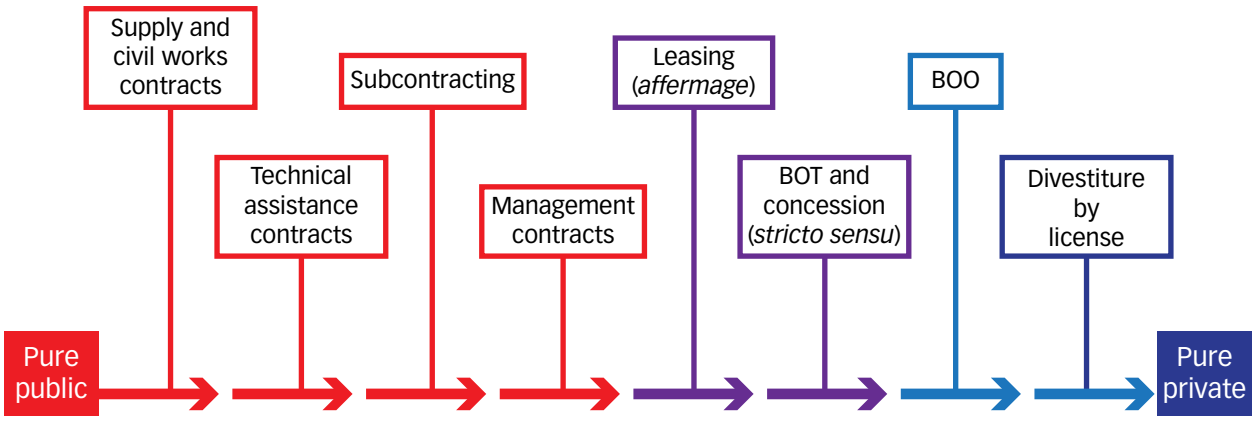
On the left side of the diagram (in red), are boxes representing the public sector's responsibilities for a publicly owned infrastructure asset. Moving from left to right, the level of private sector engagement increases in both scope of responsibility and financial risk allocation, with the right side (in blue) representing institutional arrangements under which the private sector is wholly responsible for managing the infrastructure.

While private engagement gradually increases in the first four boxes along the continuum, even management contractors, which have the greatest private involvement of the four, take little or no operating risk and are paid a fee for providing services (frequently linked with performance-based incentives).

The level and quality of the private sector engagement changes as the involvement moves to the next two steps, represented in violet. Here the private contractor assumes risk in anticipation of a return. These two stages—leasing (or *affermage*) concessions and strict concessions—represent the categories of partnerships referred to as "concessions" for purposes of this report.

The leasing stage (widely referred to using the French term *affermage*) stage represents a type of PPP in which the public sector retains ownership of the assets as well as responsibility

Figure 1.1. Concessions on the spectrum of public-private sector institutional engagement



Source: Modified from Guislain and Kerf (1995).

for making new investments and expanding the asset base. The private sector partner assumes responsibility for operating and maintaining the assets, providing the public service, and collecting payments for service. In exchange for the right to collect these payments, the concessionaire makes regular lease payments to the public sector asset owner.

The next stage—strict concession—requires the private lessor to operate, maintain, and expand the asset in accordance with carefully negotiated and specified terms. The lessor must return the asset, with all improvements, to the owner at the end of the concession period. Both build-operate-transfer (BOT) concessions for greenfield (new) interventions and rehabilitate-operate-transfer (ROT) concessions for brownfield (rehabilitated) interventions fall into this category.

The final two categories on this continuum correspond to the highest degrees of private sector involvement in infrastructure. Build-own-operate (BOO) is a scheme wherein a private entity is selected to build, own and operate an asset—typically a greenfield development—under contract with the public sector. Divestiture by license represents full private ownership, operation, and expansion of the licensed asset, typically subject to an established regulatory regime. This report does not deal with these two categories.

Certain characteristics of the rural electricity market in most developing countries limit the scope of concession arrangements and the potential of private sector participation in the sector. As a "greenfield" investment, rural electrification has a long payback period. Building long rural feeder lines is an expensive proposition, and frequently, the customers served by those lines use only small amounts of electric power. As a result, rural electrification has usually been inconsistent with the investment requirements of private investors. In other words, it is rarely profitable over the short to medium term. As a result, many concessionaires demand public grants or cost-sharing to meet the "financing gap" associated with building and operating new rural electrification lines.

As small-scale renewable energy technologies become a common part of the electrification tool kit, so does the potential to reduce the capital costs of electrification and quicken its payback period.

Forms of power concessions in Sub-Saharan Africa

A detailed review undertaken for this study identified nearly 200 electricity concessions. Many are small concessions connecting to as few as a hundred customers. Others are national utility concessions that focus less on providing service to previously unelectrified rural households than on improving the technical and financial management of the electricity distribution sector, in general.

About 15 African countries host one or more active concessions corresponding to the lease (*affermage*) or strict concession variety. Another six countries adopted electrification concessions at some point in the past 25 years but then abandoned them (see table 1A.1). Still another six (or

possibly seven) countries gave serious consideration to adopting a form of concession but then abandoned the idea.

This review identified four different types of electricity-sector concessions present in Sub-Saharan Africa (table 1.1). Each is described briefly below.

Mini-grid concessions

Mini-grid concessions cover two slightly different categories of concessions. In most instances, they generate and distribute electricity for relatively small, isolated communities that are located far enough from the national grid that the costs of extending a medium- and low-voltage line to it cannot be economically justified. They are frequently established in regions so remote that the national grid is not expected to reach them for a decade or more. The grids tend to serve between a hundred and a few thousand customers and do not offer significant scale economies. As a result, the power produced and sold by these "integrated" mini-grids is more expensive than that supplied through the national grid. Most concessioned mini-grids generate and distribute power; some serve as local distributors of power acquired from the national grid. In

Table 1.1. Four types of rural electrification concessions

Concession type	Scale (number of connections)	Demographic of clientele	Power source	Electrification technology	Type of asset
Mini-grid concessions	100–10,000 customers	Rural	Small integrated generation and distribution networks (in some instances operated as localized distribution utilities selling power from the national grid)	Mini-grids	Greenfield or brownfield
Solar home system concessions	Solar home systems can electrify one household at a time, sometimes more, and concessions can service 5,000–30,000 such systems	Rural	Solar home system	Isolated solar home systems	Greenfield
Rural zonal concessions	As conceived, 5,000–30,000 to begin, with the intent that they could grow beyond that size	Rural	Various: large, centralized power stations, small isolated generators, or solar home systems	Grid extension, mini-grids, and isolated solar home systems	Greenfield or brownfield
National utility concessions	100,000 or more	Mostly urban, partly rural	Large, centralized power stations	Grid extension and occasionally, mini-grids	Brownfield

Note: In a greenfield concession, a private entity builds and operates a new facility. In a brownfield concession, a private entity takes over an existing facility or asset, which is usually government-owned.

other cases, mini-grid concessions are provided to distribution-only networks that sell power generated by a national utility or other larger-scale generator to local areas previously unconnected to the grid. Most of the discussion of mini-grid concessions in this report refers to the former category, but in a handful of cases, the concessions referred to as mini-grid concessions are small distribution-only mini-grids. For example, in Uganda, two types of mini-grid concessions have been granted.

To operate sustainably and cover their long-run marginal costs, mini-grids typically must charge tariffs higher than those faced by customers on the national grid. The exception to this rule is encountered in cases where the national government has agreed to enforce a uniform national tariff in which other electricity consumers cross-subsidize the mini-grids' higher costs. Traditionally, mini-grids relied on diesel fuel or biomass to generate power, but small hydropower plants, where feasible, represent a cheaper generation source. Increasingly, mini-grids are making use of new renewables, such as solar photovoltaic, small hydro, wind, and biomass gasification to generate electricity. The trade-off between diesel and renewables lies in their contrasting cost profiles: renewable generation requires a greater share of capital cost: diesel generation demonstrates a higher share of recurrent, fuel-related costs.

Mini-grid concessions have been used primarily to stimulate bottom-up or "spontaneous" localized electrification networks. While some have been established through competitive selection, most have been selected and negotiated on a case-by-case basis. To date, acceptance and implementation of unsolicited proposals has been common. Most have been built from scratch but have attracted public funding to defray part, if not most, of their capital costs under public-private partnerships.

In mini-grid concessions, the risk falls largely on the shoulders of the concessionaire. Government may share some risks by contributing to the capital costs of the operation or by subsidizing fuel costs. Consumers may share the risks of rising prices through indexation formulas. But for the most part, the concessionaire must bear the risks inherent in operations, collection, system losses, shifting demand, inflation, and fluctuating rates of interest and foreign exchange. Historically, they have also been exposed to the risk of the main grid arriving sooner than expected, but good concession contracts will explicitly spell out the concessionaire's rights and responsibilities when the national grid reaches the mini-grid's service area.

Solar home system concessions

In the concessions tried in South Africa, the government contracted a private firm to install and maintain solar home systems in defined geographic areas, typically a sparsely settled area located far from the existing grid. A government considering such a concession may view certain regions as being perpetually served by solar home systems, or it may view the systems as a stop-gap pending arrival of the national grid.

In a response to a government-led solicitation, solar home system companies compete to have an exclusive or monopolistic right to supply solar home systems or electricity from solar home systems to the area. The expectation is that in return for these monopolistic rights, the concessionaire will invest its own resources in establishing supply and maintenance networks in the target region.

Only in South Africa has this type of concession been tried in Sub-Saharan Africa. The concessionaire was expected to assume the risks of capital investment, operations, collection, system losses, inflation, and fluctuating rates of interest and foreign exchange. The only shared risk was that of fluctuating demand, which was split between the participating municipalities and consumers. The latter were charged a minimum monthly service charge and the former were meant to provide a monthly operating subsidy to reduce the demand risks assumed by the concessionaire. If this concession had been established more recently, the collection risk could easily have been shared with the consumer via the use of pay-as-you-go technology. As it was not, cost-recovery remained a significant operational challenge to the continued operation and expansion of these companies.

Rural zonal concessions

Rural zonal concessions enable governments to concede the rights to electrify a large area or zone. The terms of the contract may be technology-neutral, leaving the concessionaire free to deploy whatever technology they consider most advantageous to service the area, or it may specify targets for various electrification technologies. Typically, such concessions are designed to serve a large number of potential customers (5,000–30,000 or more), but settlement density may vary from low to high within the concession zone. Most such concessions have been greenfield operations, it is possible to envision rural zonal concessions where some existing assets may already be in operation or may require renovation prior to operation.

The area of a rural zonal concessions should be large enough to permit economies of scale and its attendant benefits: lower costs, lower prices, adequate profits, and sustainability. Because of the focus on scale, some larger international companies have become involved as concessionaires. Concessionaires charge cost-recovery tariffs subject to regulatory oversight, but the government or the rural energy agency may help keep costs low by providing initial capital subsidies as part of its contribution to the partnership.

Senegal hosts the one case of a rural zonal concession found in Sub-Saharan Africa. The concessionaire bears the risks of operations, collection, system losses, shifting demand, and fluctuating interest rates. In the Senegalese case, the risk associated with the prices of purchased power and fuel is shared between the concessionaire, the government (which provides subsidies to the utility that are passed through to concessionaires in pricing), and consumers (fuel-price pass-throughs). Inflation risk and

foreign exchange risk are split between the concessionaire and consumers.

Owing to the complexity of risk-sharing formulations; the rules and standards governing multiple electrification technologies in the same contract; and the need for negotiation of capital cost subsidies, rural zonal concessions require strong institutional capacity both to establish and to regulate.

National utility concessions

National utility concessions are typically established to take over a utility that is solely responsible for the major electricity network in a country. It may be a vertically integrated utility that operates the country's entire electricity system (generation, transmission, and distribution) or it may cover only the distribution network in an unbundled system.

National utility concessions may or may not have explicit connection or access targets. Their primary purpose has been to help governments reform underperforming utilities that drain government budgets and provide poor service. Most serve more urban than rural customers, and they are not normally established for the purpose of rural electrification.

A concession for a national distribution utility gives the concessionaire a long-term right to use a set of state-owned electricity infrastructure assets for which the concessionaire usually pays an up-front concession fee and commits to investing in new infrastructure.

The concessionaire is responsible for collecting revenue from customers and for maintaining and, in some cases, expanding infrastructure. Typically, the concession is for 15–30 years, at the end of which the assets revert to the government, which then decides whether to renew the concession or to open a new tender. Tariff-setting rules and service standards are normally embodied in the contract or license provided to the concessionaire, and these cannot be unilaterally changed. Disagreements between the government and the concessionaire must be resolved through international arbitration.

The allocation of risks is spelled out in the tendering process. Generally, risk is distributed between the concessionaire, the government, and consumers according to which is in the best position to control it. The concessionaire is wholly responsible for operating risks, demand risks, and collection risks. Other risks, such as system loss risks and interest rate risks may be shared between the concessionaire and consumers. Still other risks, such as those related to fuel price, inflation, and foreign exchange, may be passed through to consumers so that the concessionaire is not burdened with factors beyond its control. One risk that has sometimes been left to the government is the fuel-price risk. In the case of Cameroon, the government has chosen to absorb the risk of fluctuations in the price of fuel and other inputs, thereby stabilizing the retail price on behalf of consumers. In Uganda, the government has passed through to development partners the demand risk from public entities.

Conditions for successful concessions

Under what conditions are concessions likely to succeed? Concessions are conceived, designed, and implemented within the context of a country's power sector, and that context is crucial in determining their success. If the institutions that manage the power sector are working well, other things being equal, it is more likely that concessions will be successful in achieving their aims. Although this review does not analyze the power sector institutions of particular countries, it is important to emphasize the crucial role of the broader sector in the success of concession projects. Particularly important is commitment on the part of major power sector institutions to see concessions succeed. In other words, the concessionaire's activities should not be undermined by other sector entities.

What are the major building blocks of successful concessions? This report has identified several; they fall into two categories: regulatory and financial. Within each category several conditions appear to result in more successful implementation of electrification concessions.

The key regulatory issues that serve as building blocks for a successful concession are:

- **Clarity.** The roles of the various parties in the concession should be well-defined and remain clear throughout the concession's implementation. All pertinent entities should be included in the process, not only the concessionaires and the government ministries, but also regulatory authorities, national utilities, and even local authorities.
- **Consistency.** Major changes in the rules of the concession's framework, in its interpretation, and in its application should not be made without prior consultation and agreement with the concessionaire and other key actors. It is vital that governments and regulators not unilaterally change the rules of the game or allow one actor to overreach or underperform with respect to its responsibilities over a concession's lifetime.
- **Flexibility.** Most concessions are set in place for a long period of time, normally at least a decade. As a result, they are exposed to changing economic, technological, and legal conditions. To respond to these changes productively, the concession framework must contain a mechanism to allow its terms and implementation to evolve in a transparent and consensual manner.
- **Nononerous compliance.** The costs of compliance should be commensurate with the nature and size of the concessions being implemented. It might be reasonable to expect detailed quarterly or even monthly reports from a national utility concession, but the same requirement may be excessive for a local mini-grid. The compliance burden needs to be matched to the complexity of the operation and the ability of the concessionaire to bear it.

The key financial issues that serve as building blocks for a successful concession are:

- **Pre-investment support.** The pre-investment period requires active support and engagement on the part of both the public and private sectors. The latter must evaluate (in a process known as due diligence) whether the concession, including all available incentives, is economically attractive and offers an acceptable rate of return. The public sector partner must not only clearly define the goals, objectives, and rules of the concession arrangement, it should also be prepared to bear some of the burden of the pre-investment (due diligence) expenses of potential private concessionaires. The necessary support could take the form of preliminary field work and data collection by the public sector owner to demonstrate likely financial viability of the concessions, or cost-sharing with potential concessionaires who wish to do their own fieldwork and analysis. Alternatively, the support may come in the form of subsidies for the construction of greenfield systems or perhaps as a reduction in the concession price (essentially an increased subsidy) to make up for shortfalls in existing brownfield concessions.
- **Need for financial viability.** Concessions are a partnership. The public partner will expect the private partner to contribute financing (both debt and equity), technical expertise, and managerial competence to the management of electricity assets. In return, the private partner expects to earn a positive financial return on its investments and for having assumed various risks.[4] Within this scheme, the public sector can support or undermine the efficacy of concessions through its attitudes and actions toward pricing and subsidies. Some, but not all, successful concessions have been conceived as operating on the basis of full cost recovery, that is, with the expectation that tariffs will cover the operator's full costs, including an adequate rate of return. Cost-sharing for the early investment stage of the concession frequently includes a one-time capital subsidy. A few concessions have continued to operate in contexts where the public partner provides a recurrent subsidy to avoid tariff hikes that the concessionaire would otherwise have to make to meet its revenue and return requirements.
- **Timely disbursement of public funds.** Successful implementation of a concession project requires that the relevant public agencies pay out funds allocated to the project in a timely manner. This applies not only to the initial capital-cost subsidies (if any) but also to any recurrent subsidies provided by the public sector over the concession period. A two-month payment delay that may be routine for public agencies could well bring a small concessionaire to bankruptcy.

Study methodology

This study was designed to explore the use of concessions in Africa to promote rural electrification. As will be seen, not all concessions have had as one of their goals increasing access to electricity among previously unconnected rural households. For that reason, this evaluation may assess some concessions against an objective that they were never meant to meet. However, the expansion of scope is justified in the search for legal and institutional arrangements that could lead to a greater flow of investment and expertise for rural electrification in Africa.

The methodology followed in the preparation of this report had three steps. The first was a desk review of nearly all electricity sector concessions in Sub-Saharan Africa from the late 1990s until 2015, when the review was conducted. These concessions fell into three categories: those implemented and still in operation in 2015; those planned but never implemented (because one or both of the partners got "cold feet"); and those implemented but abandoned for one reason or another ("buyer's remorse"). This report focuses on the first group. Non-starting and abandoned concessions are listed in annex 1A, with the reasons for those failures running the gamut from political opposition to financial nonviability and unrealistic expectations. (Table 1A.1 summarizes concessions that were initiated but terminated early, and table 1A.2 summarizes concessions that were seriously considered but never implemented.)

The second step involved the preparation (in 2015) of detailed case studies for six countries where the identified concessions or concession frameworks were still in operation. These case studies involved site visits to gather data on the legal, regulatory, and contractual arrangements employed; interviews with key actors in government, utilities, and private companies; and an assessment of the gains in rural access to electricity attributable to each concession.

The six case study countries were Cameroon, Madagascar, Mali, Senegal, South Africa, and Uganda. In addition, a brief review was done on the case of Burkina Faso, where the concession arrangement relied upon is somewhat unique, as the concessionaires are cooperatives rather than private companies. During the review, it became clear that the countries' experiences with concessions were more complex than anticipated, as in both Senegal and Uganda at least two different types of concession had been undertaken either successfully or otherwise. This provided a unique opportunity to compare two different models of concessions operating under different rules but similar conditions. The reports from each of these detailed case studies are available as separate case studies.[5]

The third and final step of the methodology was a review of electrification concession experiences and successful national rural electrification programs in countries outside Sub-Saharan Africa. These desk reviews, based largely on World Bank documents, bring to the discussion not only an idea of where concessions had proven successful at stimulating rural electrification, but also

an overview of where rapid rural electrification had been achieved with partial private sector support though without the use of concessions.

The desk review of concessions in Africa included advances in rural electrification under the concessions. To place that information in context, table 1.2 provides information about the changes in electrification in the 12 most rapidly electrifying countries in Sub-Saharan Africa (including two of the case-study countries), supplemented by the same numbers (and ranks) for the four remaining case-study countries. All countries highlighted in the table had some form of concession in place for the years from 2000 to 2012, although the concessions in Togo and Cabo Verde were terminated in 2006.

Table 1.2. Improved Access to Electricity in Sub-Saharan Africa, 2000–12: Twelve Fastest Growing and Those with Concessions

Access growth rank (#)	Country	2000		2012		Changes between 2000 and 2012		2012
		Population	National electrification rate (percent)	Population	National electrification rate (percent)	Increase in the national electrification rate (percent)	Average annual percentage growth in electrification rate	Annual population growth rate (percent)
1	Senegal*	9,860,578	37	13,780,108	57	20	1.67	3.12
2	South Africa*	44,000,000	66	52,341,695	85	19	1.58	1.55
3	Ghana	18,824,994	45	25,544,565	64	19	1.58	2.44
4	Gabon*	1,231,548	74	1,613,489	89	16	1.33	2.27
5	Lesotho	1,856,225	5	2,057,331	21	16	1.33	1.19
6	Togo*	4,874,735	17	6,745,581	31	14	1.17	2.70
7	Ethiopia	66,443,603	13	92,191,211	27	14	1.17	2.56
8	Botswana	1,736,579	40	2,132,822	53	14	1.17	2.04
9	Mozambique	18,264,536	7	25,732,928	20	13	1.08	2.82
10	Benin	6,949,366	25	10,049,792	38	13	1.08	2.73
11	Cabo Verde*	438,737	59	500,870	71	12	1.00	1.15
12	Rwanda	8,021,875	6	10,817,350	18	12	1.00	2.44
20	Uganda*	23,757,636	9	35,400,620	18	10	0.83	3.27
22	Mali*	11,046,926	17	16,112,333	26	9	0.75	2.98
26	Cameroon*	15,927,713	46	21,659,488	54	8	0.67	2.53
43	Madagascar*	15,744,811	11	22,293,720	15	4	0.33	2.80

Source: World Bank and IEA (2015).

*These countries had a concession in place during part of the period from 2000–12. The concessions in Togo and Cabo Verde were terminated in 2006.

These data demonstrate that in only two countries of Sub-Saharan Africa—South Africa and Lesotho—did the average annual rate of growth in electrification over the time span exceed the population growth rate in the final year, 2012—and in neither case is this result attributable to concessions. In all countries, annual population growth has exceeded annual access growth, demonstrating a slow record overall for electrification. Of the concession countries among the top twelve electrifiers, three had concessions still in place by 2015: Senegal, South Africa, and Gabon. In two case-study countries, Senegal and South Africa, the relatively rapid increase in electrification cannot be attributable to the concessions. In both these instances, the national utility was responsible for the rapid increase in electricity connections, with the concessions playing only a very small role in this growth. This will be further demonstrated in the subsequent analysis. For Gabon, the government and concessionaire, SEEG, cooperated to increase access, but it was still outpaced by population growth.

For the other case-study countries—Cameroon, Madagascar, Mali, and Uganda—the concession programs did not result in a rate of electrification growth increase of even 1 percent per year.

Outline of the report

Chapters 2 and 3 explore concessions in Sub-Saharan Africa aimed specifically at expanding rural electrification by means of mini-grids, solar home systems, or rural zonal concessions. Chapter 4 deals with national utility concessions that may or may not have had as one of their goals the expansion of rural access to electricity. Chapter 5 presents several cases of rural electrification from outside Sub-Saharan Africa—some of which are not formal concessions—with the aim of deriving lessons for future concessions in Sub-Saharan Africa. Chapter 6 presents conclusions.

Annex 1A. Electrification concessions in Africa: Terminated or never implemented

Table 1A.1. "Buyer's remorse"—Electricity concessions implemented but terminated early

Country	Concession or program name or description	Dates implemented	Type of concession
Cabo Verde	Electra concession	2002–06	National grid (concession)
Comoros	Comorienne de l'eau et de l'électricité (CEE)	1998–01	National grid (affermage)
Gambia	SOGEA	1992–95	National grid (affermage)
Guinea	Electricité de Guinée (EDG)	1995–00	National grid (affermage)
Mali	Energie du Mali	2000–05	National grid (concession)
Mozambique	Energia de Moçambique Concession for Northern Inhambane area	2004–07	National grid (subregion) (concession)
Namibia	Northern Electricity Distribution Lease	1997–01	National grid (subregion) (affermage)
Senegal	SENELEC	1999–01	National grid (concession)
Togo	Togo Electricité	2000–06	National grid (concession)

Table 1A.2. "Cold feet"—Planned electricity concessions that were never implemented

Country	Name	Year(s) implemented	Type of concession considered
Benin	Local rural electrification initiatives	2009	Mini-grid
Benin	Rural electrification concessions (REC)	2009	Rural zonal
Cameroon	Local project initiatives of rural electrification (LPIRE)	2008–12	Mini-grid
Cameroon	Rural energy priority programs (REPP)	2008–12	Rural zonal
Chad	Société Tchadienne d'électricité et d'eau (STEE)	2000–04	National grid
Congo, Republic of	Societé Nationale d'électricité (SNE)	2004	National grid
Lesotho	Lesotho Electric Company	2004	National grid
Madagascar	Jiro sy Rano Malagasy (JIRAMA)	2005	National grid
Mali	ZEM (priority electrification zones)	2005	Rural zonal
Zambia	ZESCO concession	2000–03	National grid

Chapter 2.
RURAL ELECTRIFICATION CONCESSIONS IN AFRICA: MINI-GRIDS

This chapter focuses on the use of concessions in mini-grid development.

A mini-grid is an electricity network built to provide service to settlements in which demand is limited and the costs of extending the national grid to the area either cannot be justified or cannot be undertaken in a timely manner. Most mini-grids are small and operate in remote areas, where they generate and distribute power for sale to local consumers. Given their localized nature, no transmission lines are needed. Because of their limited size, mini-grids seldom grow large enough or fast enough to achieve economies of scale, meaning that the power that they generate remains relatively expensive. As national grids expand, they will gradually absorb mini-grids, thereby resulting in lower unit costs for consumers. Both the outcome of lower unit costs and the need for mini-grid operators to be compensated for stranded assets need to be borne in mind and planned for in any mini-grid program.

However, in a few cases the mini-grids were granted concessions for distribution-only networks. This second subcategory of mini-grids represent cases where small distribution grids are built beyond the limits of the existing grid to connect customers living within reach of the existing national network. In such cases, the power purchased by these distribution-only mini-grids and sold on to consumers may or may not cost the same as that sold to customers of the national utility. Mini-grid concessions of this nature are found in Uganda and Senegal.

Mini-grid concessions are a form of public-private partnership (PPP) intended to provide incentives for the private sector to invest in supplying electricity to rural areas. To date, most mini-grid concessions have emerged through a somewhat informal or "bottom-up" process which the government establishes a policy framework, a subsidy formula, and an information program to attract interested private operators. Although a few countries have tried to organize public procurements to elicit proposals, most mini-grid concessions established to date have arisen from locally prepared proposals evaluated and endorsed by a rural energy agency.

All mini-grid concessions reviewed here were developed with the support of a rural energy agency that typically provided a financial contribution to the effort. While some of the concessions only sought to distribute grid-generated

power to remote rural areas, most of them operated as mini-utilities, undertaking both generation and distribution.

From this first generation of mini-grids contracted out under bottom-up conditions, there is little evidence of a clear link to planning beyond the solicitations of proposals. No national plans specified certain areas as being a priority for mini-grids—for example, because the national grid would not reach them for a certain number of years. Neither were studies of load or willingness to pay carried out to prove to investors that investments would be financially viable.

In the future, the definition of priority areas to be electrified by mini-grids operated as concessions may well be an important policy or planning prerequisite for accessing public subsidies for such ventures. Geospatial planning using geographic information systems would contribute to a more structured, logical, and financially attractive approach to identifying candidates for such concessions.

Those early mini-grids that generated their own power relied either on locally available renewable energy (such as small hydropower plants or biomass) or on diesel generators. As a result, their location and operations were limited by local resource endowments and the cost of purchasing transported diesel fuel. As solar PV systems become cheaper and more broadly available, self-contained, isolated mini-grids will be more able to operate wherever the sun shines and its energy can be stored. Existing mini-grids will see a drop in operating costs as renewable sources are increasingly incorporated into their generation mixes, but also a concomitant increase in capital costs (because the capital costs of generating energy from renewable sources are higher than those of generation using fossil fuels).

A few African countries have encouraged privately led mini-grid development without first adopting a legal concession framework. However, this approach has generated considerable uncertainty and a reluctance to invest on the part of the private sector, particularly with respect to the investors' rights once the national grid reaches their network. Those rights may be nonexistent, weakly developed, or unclear (Tenenbaum and others 2014).

The review underpinning this study identified six countries—Burkina Faso, Guinea, Madagascar, Mali, Senegal, and Uganda—in which mini-grid concessions were still in operation in late 2015. With the exception of Uganda, these countries are governed in the French administrative tradition. Table 2.1 provides details. The analysis is restricted to mini-grids that have operated under concession agreements. The discussion excludes mini-grid operations that appear to operate fully on public funds.

In all cases, the concessions were established under a program initiated by the country's rural energy agency or fund, which shouldered some or all of the capital costs of the system. These programs elicited participation from local entrepreneurs possessing the knowledge and resources to operate a mini-grid system, even if they did not have access to large pools of equity and debt investment capital. Given this financing gap, they required financial support from their

Table 2.1. Sub-Saharan African countries with mini-grid concessions

Country	Mini-grid program name	Years in operation	Number of mini-grid concessionaires and mini-grids in operation	Total number of connections made through mini-grid concessions	Average number of connections per mini-grid
Burkina Faso	Electricity Cooperatives (Coopels)	2003–present	Concessionaires = 92 Mini-grids = 92	14,250	155
Guinea	Decentralized Rural Electrification (PERD) Project	2006–present	Concessionaires = 26 Mini-grids = 26	8,248	317
Madagascar	Mini-grid concessions	2005–present	Concessionaires = 30 Mini-grids = 30[a]	7,100	237
Mali	Projets de Candidatures Spontanées d'Electrification Rurale (PCASER)	2003–present	Concessionaires = 68 Mini-grids = 250	78,000	312
Senegal	Projets d'Electrification Rurale d'Initiative Locale (ERIL)	2003–present	Concessionaires = 4 Mini-grids = 4	500	125
Uganda	West Nile Rural Electrification Project	2003–present	Concessionaires = 1 Mini-grids = 1	6,800	6,800
	Small grid extension concessions	2006–present	Concessionaires = 5 Mini-grids = 5	31,600	6,320

a. In Madagascar, 200 villages are provided with service by the remaining 30 operators, but the exact number of mini-grids is not known (some mini-grids serve multiple villages).

respective governments to meet the capital costs of building the system.

All but one of the identified programs are greenfield developments in which the mini-grids were built from the ground up. The exception is the Ugandan WENRECo mini-grid, part of which existed prior to the awarding of the concession. With the exception of the small grid-extension concessions in Uganda, the mini-grids identified in this table generate and distribute electricity to local communities. In Uganda, the concessionaires are responsible only for running the rural distribution networks built and handed over to them by the rural electrification agency: they do not generate power. The power they sell is purchased from the national grid system operated by Umeme, Uganda's national distribution utility concessionaire.

Table 2.2 summarizes the elements common to the mini-grid concessions considered in this review. Typically, the concessionaire is obliged to build, operate, and maintain the mini-grid asset, and to connect new customers who pay the connection fee. However, meeting a target to connect a specific number of new customers is not normally an obligation under such systems.

Mini-grids implemented using concession agreements have proven useful in bringing local private sector entities into rural electrification. They have tended to work best where rural

Table 2.2. Features common to mini-grid concessions in Sub-Saharan Africa

What is concessioned?	The right to build a new power plant and a distribution grid, along with the right to operate these assets to sell power to customers and to collect revenue from customers.
General obligations of the concessionaire	To build out the proposed investment, maintain and renew the equipment. To build out final distribution lines to the premises of the new subscribers. To maintain minimum service standards, including provision of electricity for a minimum number of hours per day.
Specific obligations related to electrification	The number of expected connections is in the concessionaire's business plan. Meeting more general electrification targets (beyond connecting anyone willing and able to pay the connection fee) is not typically required. Concessionaires are obligated to connect households in their service area that request a connection and pay the relevant connection fees.
Main sources of finance for investment	For up-front capital investment, 60–80 percent of the financing is provided by the government (or donors). The remainder (20–40 percent) is provided by the private sector. The private sources of finance are often informal (for example, own savings, remittances, business partners, friends, family).
How costs are recovered	The private portion of the investment cost and operational and maintenance costs are recovered through tariffs.
How tariffs are set	Concessionaires are generally free to propose tariffs that cover their costs and a reasonable rate of return. Once the tariffs are agreed upon, they may be lightly regulated either by a rural electrification agency or an electricity sector regulator.
Type and extent of subsidy	Usually the only subsidy is paid up-front by the government as a proportion of the capital costs.
How concessions are awarded	Concessions are awarded by the government or the rural electrification agency (if one exists) on the basis of proposals submitted by private firms, in response to expressions of interest or requests for proposals published by the government. Proposals cover the private entities' plans and their request for start-up funding. To date, such proposals have not prespecified the precise settlement or bundles of settlements to be awarded through the solicitation process; the process has been bottom-up.
Why governments chose this model	To accelerate the extremely low rural electrification rate. To provide electricity service to areas remaining unserved by the national grid. For isolated, low-load customers, mini-grids may be the least cost solution for electricity service provision. Experience with mini-grid concessions in Sub-Saharan Africa

energy agencies are capable of forming properly functioning PPPs, combining public and private resources to meet both capital costs and, in a few notable cases, operating costs.

At the time of this writing, no solicitation for mini-grid concessions has received bids from companies of international scale. The solicitations may have been unattractive to international firms, failing to offer the type of risk-reward profile such firms seek. They also have been configured to solicit bottom-up proposals rather than structured, detailed proposals submitted in response to formal planning and tendering processes.

Burkina Faso's approach to mini-grid electrification concessions relies on a unique structure built around electricity cooperatives. Access to electricity in Burkina Faso remains low, at about 13 percent nationwide (World Bank and IEA 2015). For those parts of the country not in the service area of the national utility, *Société National d'Electrification du Burkina* (SONABEL), the *Fond de Développement de l'Electrification* (FDE) allows cooperatives formed by village leaders and entrepreneurs to be electrified. The electricity cooperatives (*Coopels*) are then allowed to sign concession contracts with FDE.

Under the terms of this agreement, the cooperative is then responsible for recruiting a builder and a private technical operator. FDE will provide a mix of loans and grants to help pay for the construction of transmission lines (100 percent grant) and distribution lines (60 percent grant). Of these small concessions, 15 percent generate their own power; the remaining 85 percent distribute power purchased on contract from SONABEL.

Currently, 92 cooperatives operate mini-grid concessions in Burkina Faso, servicing approximately 14,250 connections. However, their long-term financial sustainability will be challenged in the near future as their diesel generating assets begin to age and require replacement. It is not clear how many of them will require further subsidies to replace the generating assets and how many will be able to obtain financing for the needed replacements.

Guinea. Under a World Bank supported project that closed in 2013,[6] Guinea established 26 rural concessions, with three more under construction. About 58 percent of the people in the concession areas were connected to mini-grids, with the rest unable to connect because they could not pay the connection fees. The Guinean concessionaires used diesel generators, although some consideration has been given to bringing renewable generation to bear. However, by late 2013 only one small hydropower plan had been tapped by the concessionaires. The remaining 25 mini-grids were operating on diesel only.

The building of these mini-grid concessions relied upon funds provided by the *Fonds pour l'Electrification Rurale Décentralisée* (FERD). The Guinean concessions were granted to local entrepreneurs following a request for proposals. The costs of the construction were shared between the private sector (18 percent) and FERD (82 percent), comprising both loan and grant components. Loan recoveries were targeted to reach 75 percent, but actual achievements amounted to 59 percent by the time the project closed in 2013. The FERD, which was established with project funds, was never converted into a permanent, sustainable financing source. As a result, a few additional systems were supported, but the process of electrifying communities using concessional arrangements to drive remote, rural electrification has ground to a halt.

Madagascar took an approach similar to Mali's, but its solicitation of local enterprises to serve as mini-grid utilities was not as effective.

In 1998, Madagascar passed an electricity reform law designed to privatize the sector. The government's main goal was to improve the functioning of the national utility (JIRAMA).

The law unbundled the industry and brought in a private concessionaire to operate the utility. While the JIRAMA reforms were unsuccessful—because the private sector concessionaire was unwilling to operate the concession at a loss at regulated prices—the utility reverted to public ownership and management. The rural electrification agency began its operations in 2004. Several private operators took the opportunity to apply for subsidies to build small mini-grids, mostly powered by diesel-fired generators. The new rural electrification agency also tried, unsuccessfully at first, to run public tender processes to select concessionaires for designated areas.

What has emerged is a process of bottom-up development of mini-grid licensees or concessionaires. Systems generating more than 500 kW were made to compete for concessions, whereas systems below that size were considered licensees and not required to compete.

Since 2004, therefore, Madagascar has been granting mini-grid concessions to private operators to electrify rural areas. Originally, 47 operators were involved, but this number has since declined to 30 private rural concessions (or authorizations). The remaining firms operate mini-grids that provide electricity to around 200 villages, serving approximately 7,000 consumers in all. Most serve from 100 to 1,000 connections. Despite the efforts of these private players, the national electrification rate in Madagascar is still low (at 15 percent) and the rural electrification rate has remained stable at about 5 percent for the past decade.

As of September 2015, the 30 private operators generate power using diesel, biomass, or small hydro generators with capacities ranging from 40 kW to slightly more than 200 kW. The majority obtained their authorization contracts through bottom-up proposals being accepted by the Agency for Development of Rural Electrification (ADER), as allowed under the law. These proposals were required to include a workable business plan and the agreement of the community in question.

The Malagasy government had hoped to connect more than 80,000 rural households using concessions. That objective has not been realized for several reasons:

- The operating costs of the widely used diesel-fired generators increased dramatically when diesel subsidies were removed beginning around 2012. Private operators reported that the tariffs needed to recover fuel costs were higher than consumers' willingness (and ability) to pay. As diesel-fired mini-grids went out of business, the number of households served by mini-grids declined from a peak of 9,000 in 2012 to 7,000 in 2015.
- The universal access subsidy intended to finance rural projects has not been disbursed to rural private operators as promised. Instead, the funds raised by this levy have been used predominantly to meet the losses of the national utility, JIRAMA.
- Reforming JIRAMA has consumed the attention of policy makers since 1998. The failed privatization process in the early 2000s was

followed by a management contract between 2005 and 2007 that ended acrimoniously. Not only does JIRAMA remain state-owned and in in poor financial condition, but it absorbs all of the attention given to the electricity sector.

The Malagasy government had plans to develop larger rural zonal concessions that were expected to use renewable energy technologies, particularly hydro and biomass. The aim of the plan was to support larger concessions and begin to achieve some economies of scale. However, these plans have not yet come to fruition as JIRAMA continues to utilize all available electricity-sector funding to subsidize itself.

Mali's spontaneous bottom-up mini-grid concessions have succeeded in providing electricity to about 78,000 rural households since the program began in 2003. The concession approach evolved largely independently of broader electricity sector reforms. In 1999, Electricité de France set up a mini-grid in Mali. This appears to have inspired replication in other projects. In 2004, the government created the rural electrification agency, AMADER (*Agence Malienne pour le Développement de l'Energie Domestique et de l'Electrification Rurale*), the main goal of which was to expand access to electricity in rural and peri-urban areas.

With World Bank support, AMADER initially tendered out rural zonal concessions of around 10,000 customers, but with no success. Simultaneously, AMADER issued tenders for mini-grid concessions, which also proved unsuccessful.

Finally, a third approach focused on spontaneous local proposals—*Projets de Candidatures Spontanées d'Electrification Rurale* (PCASER)—attracted significant interest from small entrepreneurs who continue to develop and operate mini-grids under concession agreements up to the present.

Under PCASER, interested parties proposed to AMADER to build mini-grids with a generation capacity of less than 250 kW. More than 250 such mini-grids are operating in the country, run by 68 private entities and the vertically integrated electricity utility, Energie du Mali. The majority of these projects are powered by diesel generators, but some are converting to hybrid solar-diesel technologies with support from the World Bank's Rural Electrification Hybrid System Project (P131084). Private operators typically manage between one and four mini-grids, with the largest managing 15 mini-grids in 31 municipalities.

AMADER subsidized the investment costs of new connections and has also subsidized on average 75 percent of the capital investment costs of new installations of equipment. Private operators have financed the remaining costs. Private concessionaires are expected to recover their investments, operations, and maintenance costs through tariffs. As a result, the price of electricity from these mini-grids is currently around $0.50 per kWh, roughly three times the amount paid by the customers of the national grid. AMADER is building on its experience with the PCASER concessions and encouraging private

concessionaires to build out larger projects based on solar-diesel hybrid generators.

The PCASER projects reveal a trade-off between the speed of project approval and good governance. AMADER holds a great deal of responsibility over the rural electricity sector, serving as both promoter and regulator. As a result, complaints have emerged about the degree of discretion exercised by the agency, its decision-making process, and whether or not its procurement process is "least-cost."

The long-term sustainability of the Malian mini-grids is now being tested, with some discontent emerging regarding the relatively high cost of the diesel-based power they provide. For those concessionaires able to participate in the solar-hybridization program, operational costs will undoubtedly decline, improving their financial status. But as some of the equipment they procured at the outset of the concession nears the end of its useful life, it is not clear that the concessionaires will be able to replace it. In recent months, some shaking out has occurred among concessionaires; this has allowed the more successful ones to consolidate and even expand their holdings.

Senegal's *Electrification Rurale d'Initiative Locale* (ERIL) program was intended to stimulate the development of small, bottom-up village-level concessions that would operate in isolation from the network of SENELEC, the national utility. The procedures adopted were meant to undertake two competitive tenders for mini-grid concessions each year. The Ministry of Energy established detailed guidelines and formulas for the program, covering the allocation of subsidies, the collective purchase of equipment, and the selection of engineers and construction firms to be hired by the *Agence Sénégalaise d'Electrification Rurale* (ASER). However, the complete bidding process occurred only once (in 2006), with four mini-grid concessionaires selected for support.

Three of the four ERIL concessions were established by local entrepreneurs; the other was established by donors. Under these concessions, the assets are state-owned and tariffs are determined by the regulator, rather than ASER. Altogether, only about 500 electricity connections have been made in rural villages through the ERIL mini-grid concession program. Although ASER discussed moving ahead with another phase of the ERIL concession solicitation, no further action has been initiated, as ASER's attention became consumed by the rural zonal concessions (see Chapter 3).

Uganda has gone through two waves of creating mini-grid concessions. The first involved the establishment of a concession around a small, isolated grid that had been run by the Uganda Electricity Board before the unbundling of the electricity sector, which began in 2001. The asset was an isolated grid in the West Nile region in northwest Uganda. It originally operated a 1.5 MW diesel generator and sold power to about 1,200 customers. In 2003, the West Nile Rural Electrification Company (WENRECo) was awarded a 20-year concession to build and commission a 3.5 MW hydropower plant on the Nyagak River and a new 1.5 MW diesel generator.

The new diesel gen-set was commissioned in 2004, but the terms of the concession prohibited any tariff hike until the hydro plant was completed. This placed considerable financial strain on WENRECo. The World Bank originally provided support to WENRECo for the construction of the small hydro plant, but the firm's financial difficulties increased to such an extent that construction was discontinued in 2009. With support from KfW, the German development bank, WENRECo completed the plant in 2012. Since then, it has increased its customer base from the original 1,200 to 6,800 by early 2015.

WENRECo's situation has now stabilized, and its target of a 15 percent return on investment is finally within sight. Its prospects beyond 2019 are not yet clearly defined, however, as the company's mini-grid is expected to be connected to the national grid at that time. As the concession was granted for 20 years (that is, until 2023), the next steps are unclear.

The second wave of Uganda's establishment of mini-grid concessions, begun in 2006, continues to the present. Because private players had not come forth on their own to request concessions to build new electricity networks, the Rural Electrification Agency decided to finance and build new grid extensions, and then lease them out to private concessionaires. The rationale was that the public involvement in construction would reduce the risk to concessionaires by demanding less private capital to get started and thereby opening the door to local entrepreneurs.

The national distribution company, Umeme, was not considered eligible to operate these new systems. As a result, five operators with little or no experience or technical expertise were granted responsibility for the new mini-grids, which collectively distribute power to about 31,600 connections.

Viability and impact of mini-grid concessions

Have mini-grid concessions in Sub-Saharan Africa been successful in leveraging private investment? Have they been financially sustainable? What has been their impact? Table 2.3 summarizes some of the answers to these questions.

Raising private investment

Because of how mini-grid concessions have been selected and developed—that is, in the absence of a formal competitive process on a large scale—it is difficult to gauge their ability of to bring in significant sums of private investment.[7] Most operators remain local in orientation and small in scale, and no initial public offerings for mini-grid concession companies serving communities have taken place. Still, it is clear that the investments made by the operators tend to be relatively small and are commonly shared with the public sector, with the latter typically providing the lion's share of the capital requirements.

Nevertheless, given the relatively limited profitability of initial rural electrification, investments that leverage as much as 20 percent from private sources represent a positive step and help extend the reach of limited public sector electrification financing.

Table 2.3. Financial status of mini-grid concessions in Sub-Saharan Africa

Country	Concession or program name or description	Estimated value of private investment in concession	Estimated value of public investment in concession	Explanation of investment mix and financial sustainability of concession
Burkina Faso	Coopel	—	—	The limited available information suggests that Coopels are unlikely to meet long-run marginal costs of operation.
Guinea	PERD	$0.4 million	$1.737 million	Total value of mini-grid investments estimated at $2.137 million. No evidence available on financial sustainability of concessions.
Madagascar	Mini-grid concessions	$5.95 million	$13 million	When government stopped subsidizing diesel, 17 of 47 mini-grids closed down. Some operators claim ability to recover initial investment costs and operating costs, but long-run prospects remain uncertain in the absence of fuel subsidies.
Mali	PCASER	$13 million	$39 million	Ability of concessions to cover long-run marginal costs and achieve full sustainability not yet clear. Mini-grid market currently transitioning.
Senegal	ERIL	—	—	ERIL mini-grids were meant to be bottom-up mini-grids largely funded by development partners. Insufficient evidence available on financial sustainability.
Uganda	WENRECo	Unspecified own resources invested. Loan of $12.3 million.	Initial grant of $14.75 million made available from REA using World Bank funds.	After initial financial difficulties, tariff rise and restructuring, WENRECo appears on target to achieve 15 percent return on equity.
Uganda	Small grid distribution concessions	—	—	Two of the five operators in this category presently appear to be on sound financial ground. Insufficient information to judge the situation for the remaining three.

— = data not available.

In Guinea, the local private operators provided 18 percent of the capital investments. The remaining funds were provided as a mix of grants and public loans.

In Mali, mini-grid concessions have attracted at least $13 million in private investment from the local firms engaged. The estimate is that on average, AMADER pays 75 percent of the investment costs for rural concessions,[8] placing the total value of the investments at $52 million.

In Madagascar, the mini-grids have invested a little over $6 million in private resources into their concessions. In theory, this amount was to have leveraged approximately three times its value in

subsidies from the Fonds National d'Electrification, bringing the total value of the investments to roughly $24 million. However, several concessionaires stated that they had not been paid the full amount of the subsidy they were promised, owing largely to JIRAMA's failure to turn over to the rural energy agency the surcharges it collects. This means that more resources than expected were drawn from the private sector because JIRAMA was allowed to prioritize its own financial needs over its obligations to the Fonds National d'Electrification.

For Mali and Madagascar, the private investment amounts to between 25 and 30 percent of the total investment in the mini-grid systems. On average, for Mali, the private investment comes to approximately $167 per customer out of a total investment of $667 per customer. For Madagascar, the private investment comes to approximately $845 per customer out of a total investment of $3,380 per customer. The enormous difference in the overall cost per customer in the two countries ($667 vs. $3,380) is largely attributable to the harnessing of small hydropower resources for mini-grids in Madagascar versus reliance on diesel-only systems in Mali.

In Uganda, WENRECo—which is owned by Industrial Promotion Services, a subsidiary of the Aga Khan Fund—has invested its own resources into the concession. It has also obtained loans from KfW and Centenary Bank totaling $12 million, as well as grants from KfW ($1.3 million) and from the Rural Electrification Agency ($14.75 million in World Bank funds). The total financing support provided to WENRECo from outside sources therefore comes to $27.05 million. The other five Ugandan rural concessions that operate distribution networks have invested little or no private capital into their operations.

All of the mini-grid concessions reviewed in this report (with the exception of the five Ugandan distribution-only mini-grids) have managed to draw upon private sector debt or equity funding for a portion of their capital needs. While in no case has the level of private funding constituted the majority of the financing, in all cases the private sector resources have helped to move these projects from the drawing board to implementation.

Maintaining financial sustainability

In terms of financial sustainability, the mini-grid concessions demonstrate a mixed record.

In Mali, most of the concessionaires appear able to recover their initial investment costs and operating costs. However, their ability to replace outdated capital (in terms of generators and prepayment meters) has not yet been demonstrated. The larger concession operators in Mali know which of their individual mini-grid projects are financially sustainable and which are not. At present, the concessions in Mali seem to be facing a period of winnowing and consolidation.

In Madagascar, 47 mini-grids were operating successfully as licensees or concessionaires prior to 2013. By 2015, that number had declined to 30. The decline is directly attributable to the removal of the subsidy on diesel, which had helped hold down operating costs.

In Uganda, WENRECo initially struggled to stay in business, particularly due to the conditional prohibition against raising tariffs until a small hydropower plant was completed. It now appears to be heading toward its goal of 15 percent return on equity. However, the Ugandan government has decided to connect the WENRECo grid to the main national grid in 2019—before the end of the 20-year concession period. The government then expects WENRECo to operate the entire service territory in West Nile, which will require adjustments to the terms of the concession.

Two factors shape the ability or inability of mini-grid concessions to achieve financial sustainability. First, mini-grids demonstrate few economies of scale and therefore tend to produce and supply expensive electricity when compared to electricity generated on the national grid.[9]

Second, unless mini-grid concessionaires are able to compensate for these higher prices by raising tariffs, obtaining subsidies, or reducing costs by generating from cheaper sources, their financial sustainability remains a challenge. Even if the regulator or the concession contract allowed them to charge higher prices, customer dissatisfaction at having to pay much higher prices than fellow citizens attached to the main grid makes continual price rises a challenging prospect. Several concessions in Mali that were relatively close to the grid have faced so much political opposition to their proposed tariffs that their systems were eventually bought out by Energie du Mali on an accelerated basis in order to avoid the political backlash associated with the markedly higher tariff.

Impact

Mini-grid concessions have increased the number of rural electricity customers in the countries in which they have been established. Preparing the policy, legal, and regulatory foundation for the concession system requires thoughtful groundwork. For example, in Mali, the Electricity Ordinance establishing the policy framework was passed in 2000, but no substantial mini-grid construction took place until 2006. It allowed for the establishment of three types of concessions. The spontaneous, bottom-up variety was the only type that flourished under the PCASER model. In Madagascar, the electricity reform law was passed in 1998, but the first projects were not tendered until 2004. As of 2015, the country was still working to adopt a legal framework for PPP's that would clarify the roles and protections extended to private partners. The WENRECo mini-grid concession in Uganda was perhaps the quickest to implement, possibly because an existing asset was available and the entire sector was being unbundled according to the Electricity Act of 1999.[10] The bidding process was initiated in 2001, and the contract for the 20-year concession was signed in April 2003.

In terms of the pace of connections, the Malian PCASER mini-grids collectively managed to make approximately 78,000 rural connections in slightly more than nine years, for an average of slightly less than 10,000 connections per year.

These households are estimated to account for nearly 577,000 rural inhabitants. In Madagascar, during the 2004–15 period, the average number of rural connections made each year by mini-grid concessions was 700.

WENRECo made approximately 467 connections per year on average during its 12 years of operation. However, during the company's financially unstable first decade from 2003 until 2012, roughly 210 connections were made per year, as the total customer base rose from 1,200 to just 3,300. When its financial difficulties were resolved in 2012, its connection pace increased to almost 1,200 connections per year, representing 3,500 total connections in three years.

The second wave of concession awards in Uganda were distribution-only mini-grids. This wave began in 2006, with the first two contracts signed in 2007 with KIL and Ferdsult, which, by the first quarter of 2015, had developed customer bases of 7,700 and 19,500. Two more agreements were signed in 2011 with PACMECS and BECS cooperatives. These had reached 2,200 and 4,200 customers, respectively, by the first quarter of 2015.[11]

The mini-grid concessions reviewed here have unleashed local entrepreneurs and enterprises, creating an avenue for local investment and for the bottom-up emergence of small electricity networks in rural areas. Mali may have implemented the most successful mini-grid concession program to date, one that has resulted in more than 70,000 people gaining access to electricity.

By and large, African mini-grid concessions require public and private cost-sharing. The typical cost breakdowns range from 60 percent to 80 percent public funding. But when the point of comparison is rural electrification projects with 100 percent public funding, these mini-grid concessions have demonstrated an approach where private financing and expertise can be brought to bear. The challenge for the future will be to find ways to effectively increase their leverage, impact, and sustainability.

Advantages and disadvantages of the mini-grid model

This review has identified several advantages and disadvantages of the mini-grid concession model as applied to date.

Advantages

Concessions for mini-grids have shown a number of advantages for rural electrification, including the following.

Mini-grids are a technically and economically optimal solution in some areas. Mini-grids are often the best choice to connect small and geographically remote settlements and villages over the short to medium term. The International Energy Agency estimates that almost half of the 315 million people in rural areas of Sub-Saharan Africa who gain access to electricity in the next 25 years will do so through mini-grids. Although the IEA's projections have not received universal acceptance and are viewed as

being too optimistic about the long-term role of mini-grids, it is accepted that mini-grids have a significant role in increasing access to electricity in Sub-Saharan Africa.

Mini-grids tap market forces. Bottom-up concessions in Mali and Madagascar have revealed the existence of local entrepreneurs, business leaders, and developers interested in obtaining mini-grid concessions and willing to invest in mini-grid projects to serve their communities. Such local entrepreneurship, while not universal, has proven an important force to be harnessed in cases where it is present.

Mini-grids develop local entrepreneurial talent and local solutions. Mini-grid concessions are entrepreneurial ventures in which private operators face substantial risks and have strong incentives to reach commercially viability. Some of the entrepreneurs who undertake these projects are local, and even foreign operators typically take local partners.

Mini-grids attract private sources of financing from local sources. Mini-grid concessions can generate private investment in rural electrification, though private operators typically provide only part of the financing for the mini-grid investment. In Guinea, Madagascar and Mali, the private portion of the investment cost came from personal investments, friends, business partners, or local investors. Even if these private resources represent a minority of the total investment cost, they supplement the limited public resources available for rural electrification.

Disadvantages

Concessions for mini-grids have shown a number of disadvantages or weaknesses for rural electrification, including the following.

Owners/operators lack capital. In rural Africa, the local businesses, entrepreneurs, developers, and citizens who are best positioned to undertake mini-grid projects have limited access to equity and debt. Lack of capital and limited access to finance limit the large-scale development of mini-grid concessions.

Financial viability can be marginal. Up-front capital subsidies can close the viability gap and help concessionaires get started. However, local concessionaires have proven susceptible to shocks that test their financial strength. Many mini-grids run the risk of being unable to recover from customers the costs of unforeseen increases in the cost of diesel fuel or the high capital costs of tapping renewable generation sources.

Future integration with the grid is often not adequately planned for. Connecting a mini-grid to the national grid raises many issues. Perhaps the most important question is this: When the main grid reaches the mini-grid, on what terms should the mini-grid be folded into the main grid operator? Assuming that the mini-grid has been built in a manner consistent with grid standards, its assets presumably have some residual value for which the private operator should be compensated. Concession guidelines need to make both the technical standards and the compensation formula explicit.[12]

Planning for mini-grid bidding has not yet attracted larger international investors. To date, none of the mini-grid concessions identified have been bid out as part of a detailed electrification planning program that would attract larger, international investors keen to operate multiple mini-grids in the same country, thereby taking advantage of economies of scope. As electrification planning comes to take greater advantage of geospatial analysis, governments should be able to identify and bid out multiple sites that are ripe for mini-grid concessions.

Suggestions to improve future mini-grid concessions

Two developments are likely to help mini-grid concessions work better in the future. First, the shift from reliance on diesel fuel to renewable energy promises to lower mini-grids' operational costs. Second, new technology—such as pay-as-you-go, smart meters, and remote control—can improve their financial viability. Rapid technological innovation can quickly make unattractive installations more attractive and sustainable.

Experience to date has brought to the forefront five areas in which future mini-grid concession arrangements can be improved over those reviewed in this study. These recommendations are:

Improve access to outside financing. Private operators starting mini-grid concessions rely for the most part on their personal wealth, networks, and business associates for start-up capital and ongoing financing. Local banks rarely finance such operations. Governments and donors could provide policy support to local commercial banks to help them extend loans to start-up operators or concessionaires in need of working capital or capital for expansion of their networks. The tenor of the debt is critical if tariffs are to be affordable. Short-term financing forces concessionaires to charge higher tariffs, squeezing customer affordability. Similarly, it would be helpful to devise, for future mini-grid concessions, "patient" equity investments that are not focused on quick returns. For example, if national utilities were able to provide or guarantee long-term financing to mini-grid concessionaires, they would be better able to synchronize the timing of their connection and take-over of the mini-grid to the payback period of the financing.

Designing mini-grid concessions around existing (brownfield) networks—something found only in the case of WENRECo in Uganda—would provide a way to quickly increase the equity base of small, local concessionaires.

Provide significant subsidies. Mini-grids in Africa need subsidies to bring their systems quickly to the point of financial viability. Such subsidies are needed to overcome the lack of ready financing, the significant perceived risks of building and operating mini-grids, and the limited willingness and ability to pay found in many rural communities.

Implement tariffs that promote financial viability. Tariffs, combined with subsidies, should allow the concessionaire to be financially viable. Governments need to be aware that without recurrent subsidies, private concessionaires

will have to raise tariffs frequently to keep up with rising costs. Without the ability to adjust prices either through tariff hikes or recurrent subsidies, private participants will not find mini-grid concessions attractive enough to meet their risk-reward requirements.

Develop a transition path to reach utility scale and connect to the national grid. In the 10-year to 30-year life of a mini-grid concession contract, the main grid may reach the mini-grid's service area. Private developers need regulatory certainty about what options will be available to their business: selling out, becoming a local distribution utility, or becoming a small power producer. Mini-grid operators should also be able to merge with one another and, if successful, to become a successful, integrated electrical utility on their own.

Encourage common ownership/management of several mini-grids. Because of their small size, mini-grids are rarely able to take advantage of the economies of scale that are so crucial to the economical delivery of electricity. This problem can be mitigated by allowing one firm to operate several mini-grids. The economies and savings can then be captured in administrative functions, engineering design, and repetition. A system of efficiently run mini-grids operating at similar sizes, utilizing the same generation, distribution, and metering approaches, and owned by the same company using one business model can be expected to be more viable than a collection of mini-grids owned and operated by different companies using different systems, technologies , and metering approaches.

Chapter 3.
RURAL ELECTRIFICATION CONCESSIONS IN AFRICA: SOLAR AND ZONAL

Our desk review of concessions in Africa found two cases, each unique to one country. South Africa had tried what can best be described as a policy experiment of using concessions as an approach to providing basic electricity services to populations in remote areas using solar home systems. Senegal—which had tried and failed to turn its power utility, SENELEC, into a concession while also implementing mini-grid concessions—began a process creating new zonal concessions and putting them out to bid for international investors. Both approaches have been challenging to implement. Because they provide some interesting lessons and reinforce points raised elsewhere in this report, they are reviewed below.

Solar home system concessions

South Africa is the only country in Sub-Saharan Africa where concessions have been granted to private companies to provide electricity to isolated rural communities using solar home systems.

Following the election of South Africa's first post-Apartheid government in 1994, concerted efforts were made to increase the proportion of the population with access to electricity. In 1998, the South African Department of Minerals and Energy (DME) promoted a joint venture between Eskom, the national utility, and Shell, giving the venture exclusive rights to install up to 50,000 solar home systems in rural areas, including parts of Kwa-Zulu Natal and the Eastern Cape (University of Cape Town Energy Research Centre 2004).

In 1999, the government introduced a new policy of concessions of solar home systems to provide access to electricity in other areas that remained outside the reach of the existing electrical grid. Following a competitive process, six companies were awarded concessions. These companies had a five-year exclusive right to government subsidies for the installation of solar home systems in pre-defined concession areas. Seven concession areas were covered, with one company being awarded two areas.

The subsidy provided by the government was set at 80 percent of the capital cost of each solar home installation. The concessionaire was to finance the remaining 20 percent of the cost, install the system, and then maintain it for 20 years. The concessionaire would recover its 20 percent share of the investment costs by collecting monthly fees from the users. In the case of poorer households,

the municipalities would extend subsidies provided by South Africa's Free Basic Electricity policy to the concessionaire on behalf of these poorer users. The plan was to install 50,000 subsidized systems in each of the seven concession areas, for a total of 350,000 units.

Experience with South Africa's solar home system concessions

The Shell-Eskom concession encountered challenges soon after commencement and halted the installation of systems. It was formally disbanded in 2006, and Eskom, which has the constitutional responsibility for providing electricity to the country, no longer participated in the concession of solar home systems. Responsibility for the maintenance of the systems installed by Shell-Eskom was assumed by three "maintenance only" companies (Wlokas 2010). Only one of these maintenance firms—Ilitha Cooperative—was still operating in Eastern Cape Province in 2015.

In the other seven concession areas, about 100,000 solar home systems were installed. However, for various reasons, fewer than 62,000 of these systems remained in operation in 2015 (table 3.1). The low number was not linked to the suitability of the solar home systems installed: Maintained properly, the original PV systems continued to operate by 2015. The problem was the business model, which proved much less resilient and stable than the solar systems themselves. Although the reasons for the abandonment of systems vary, two challenges loom large: encroachment from the grid and nonpayment by municipalities.

Table 3.1. South Africa's solar home system concessions and their active customers

Concessionaire	Province	Estimated number of units in operation (September 2015)
Kukhanya Energy Services (KES)	Kwa-Zulu Natal	30,700
Nuon RAPS Utility (Pty) Ltd	Kwa-Zulu Natal	18,000
Solar Vision (Pty) Ltd	Limpopo	6,600
Ilitha Cooperative[a]	Eastern Cape	6,300
Total		61,600

Source: Consultant interviews with CEOs of each concession.

a. Ilitha Cooperative has assumed responsibility for operation and maintenance of the solar home systems installed through the Shell and Eskom concession, which both partners abandoned in 2006.

In terms of nonpayment, South Africa's Free Basic Electricity Policy committed the municipalities to pay for the electricity consumed by the poorest households in the community. Solar Vision manages to collect nearly 82 percent of its revenue from the municipalities served and the remainder from the customers themselves. In contrast, Nuon RAPS was forced to recover the lion's share of its fees from its customers and estimated that its recovery rate was roughly 70 percent. KES noted that recovering its fees from the municipality can take as long as a year. The Ilitha Cooperative assumed responsibility for roughly 6,300 of the solar systems originally supplied by the Shell-Eskom concession, but it draws its revenue from the monthly service fees on roughly 1,640 of the systems. While the cooperative does not fully recover its costs, it is working to collect a larger fraction of the monthly fees to which it is entitled. Meanwhile, because Ilitha is a

cooperative, it feels less pressure to achieve full cost recovery than do private competitors.

On balance, the overall recovery rate for these concessionaires is lower than that of a well-operating utility. The situation is made more difficult by the fact that a significant portion of recurrent costs is supposed to be supplied by local governments on behalf of the poorer households. None of the concessionaires has been able to reach the original target size of 50,000, considered by DME to be the sustainability threshold. Solar Vision does not even support 10,000 customers. In short, while the concessionaires survive, they do not thrive.

With respect to encroachment, as part of the subsidy approval process, the concessionaires were obliged to provide an application that included Eskom's plans for the areas in which solar home systems were to be installed. The DME would then confirm that this area was in need of service and would approve the subsidies needed by the concessionaire to proceed. Concessionaires then built energy stores as a base for contact with the local population, expecting each store to serve an area within a radius of approximately 50 km.

However, if offered the choice, the local population preferred access to the grid over solar home systems and thought nothing of breaking their 20-year contractual obligation to pay for the energy delivered by the solar home system. Eskom, which has the constitutionally specified mandate of electrifying the country, was free to expand its electrification plans to some of these areas, thereby undercutting the concessionaire's exclusive right. With neither legal protection nor a right to compensation, the concessionaires were left holding the short end of the policy-experiment stick.

The three surviving concessions still operate on the basis of undertaking both installations and maintenance. However, some new community entities have emerged that focus only on operating and maintaining existing systems. The government has moved away from the concession approach to a model under which it pays independent service providers directly for installations and then hands over maintenance to user cooperatives. So while remnants of the South African solar home system concessions remain in operation, the concession approach has been deemed a failure and will no longer be part of South Africa's electrification efforts.

Viability and impact of South African solar home system concessions

Raising private investment resources. The expectation of the concession program was that the winners of the seven concession agreements would quickly be able to sign up and provide service to 50,000 customers. With this scale in mind, it was assumed that the bids would be attractive to larger international investors. Indeed, some of the initial concessions did attract international partners.

Unfortunately, DME made the concessionaires bid for village-scale projects involving 1,000 to 3,000 households, instead of awarding concessions on the basis of the originally stated scale. Neither exclusivity nor the 20-year contract

period were fully respected by Eskom.[13] With the exception of Nuon, the international investors had all exited the market by 2010.

DME also changed the capital-cost payment formula from a fixed amount per installation to a commitment to cover 80 percent of the capital cost. However, even the 80 percent coverage proved flexible in the face of individual negotiations. Although the value of the private resources invested through the solar home system concession program cannot be reliably measured, there is little evidence to indicate that the program brought in any private sector investment.

Maintaining financial sustainability. The concessions in South Africa have not been able to maintain financial sustainability. The reasons are that they never reached the anticipated scale; they were unable to effectively recover all of their fees from their customers or the municipalities; and they suffered considerable encroachment from the grid operator. Of the original six firms that won concessions under the program, only three remain, and two of those are in the hands of different owners.

Nevertheless, those operating the concessions are managing to survive, even if they do not turn a profit. However, as noted, DME is now pursuing another approach to off-grid electrification that contracts a firm to install solar home systems and then assigns the responsibility for system maintenance to a cooperative. Hence, there is no likely future for the concessions beyond the end of the contract period. The same cannot be said about the solar home systems installed. Although recent innovations in the market have made them obsolete, many of these systems continue to provide basic electricity to the households and businesses using them.

Impact. South Africa never came close to its goal of serving 350,000 rural households through concessions of solar home systems, and the approach is no longer being pursued by the South African government. The concessionaires appear to be playing out their 20-year concession agreement, but the consensus is that the policy experiment has failed. There are very effective business models evolving to stimulate and facilitate rural electrification using solar home systems, but the concession model is not one of them.

Rural zonal concessions

Zonal concessions grant rights to provide electrical service within a delimited area. Senegal is the only Sub-Saharan African country that has implemented rural zonal concessions. (Mali attempted to design such a program, but abandoned the initiative.)

The *Agence Sénégalaise d'Electrification Rurale* (ASER) prepared the Programmes Prioritiaires d'Electrification Rurale (PPER) program in 2003. During preparation, ASER identified 18 large target areas not served by SENELEC, the vertically integrated national utility.

In 2004, the process of bidding out these concessions began, but not before their number was reduced from the initial 18 to 10. The first agreement was signed with the private partners in 2008 and became operational in March 2011. From late 2011 until late 2014, another five concessions

entered into force, bringing the total number to six at the time of this review (late 2015).

The concessions were meant to be technology-neutral. Concessionaires were free to select the electrification technologies—grid extension, mini-grids, or solar home systems—best suited to supply electricity at the lowest cost to the rural population to be served. In consultation with the regulator, ASER drew the concession areas so that they would each contain between 10,000 and 30,000 potential customers in the hopes of ensuring some economies of scale. Table 3.2 summarizes the approach taken in Senegal.

Senegal's experience with zonal concessions

The intention of the PPER program design was to identify large zones that would provide sufficient numbers of customers to attract international companies. Concessions of 10,000–30,000 customers were expected to be large enough to be

Table 3.2. Typical features of rural zonal concessions in Senegal

What is concessioned?	25-year rights to provide electrical service within a defined area.
General obligations on the concessionaire	Design and build the installations, maintain and renew the equipment. Perform the electrical installation for new subscribers. Provide services for at least six hours per day (7 pm–1 am). Recover tariffs from users and be responsible for the operation of its assets.
Specific obligations related to electrification	Concessions are awarded on the basis of the number of households that the private parties propose to electrify in the first three years of the concession. The winning bidders have contractual obligations of between 7,500 and 27,000 connections each.
Main sources of finance for investment	The government provides significant up-front funding of capital costs. In Senegal, the share of private financing ranges from 22 to 68 percent of the total financing.
How costs are recovered	Concessionaires must recover their investment costs and the costs of ongoing operations and maintenance through their tariffs.
How tariffs are set	A tariff system is agreed with the regulator (CRSE). For small residential subscribers, the tariff is fixed depending on the number of lighting and power outlet points. For subscribers who require more power, billing is done according to measured consumption.
Type and extent of subsidy	The concessionaires receive a subsidy from the rural electrification agency (ASER) for a portion of their initial investment cost. They do not receive a subsidy of their ongoing operation and maintenance costs.
How the concessions are awarded	The concession contract is awarded following an international tender. The winner is the operator that proposes to connect the largest number of households during the concession's first three years, in return for a pre-determined output-based subsidy.
Why Senegal chose this model	Senegal has attempted several times to increase private sector participation in electricity so as to reduce the burden on the state of subsidizing the operations of the national utility, SENELEC.

economically attractive. The total number of customers in the concession areas was estimated to be approximately 107,000.

All of the six concessions have an international partner that is either an electrical utility (Morocco's ONEE, Tunisia's STEG, or France's EdF) or a producer of renewable energy equipment (ENCO/Isofoton[14]).

By October 2015, four of the six concessions had begun supplying electricity to customers. The total number of connections made by all concessionaires as of late 2015 was approximately 3,700. More customers (approximately 2,500) were connected via solar home systems than via grid extension (approximately 1,300). The implementation of the concessions has been significantly delayed and the uptake of service in the concession areas has been slower than expected.

The electricity sector regulator, the *Commission de Régulation du Secteur de l'Electricité* (CRSE), has power over the PPER concessions. The tariffs and service standards are initially specified in the concession contract but may be revised on a five-year cycle or on an exceptional basis, if the financial conditions originally established in the contract have changed.

Concessionaires must charge cost-recovery tariffs for each of the electrification technologies deployed. If a concessionaire planned to undertake grid extension and purchase power from SENELEC, the tariff would be set as the national medium voltage tariff minus 25 percent (representing the distribution cost), plus a small royalty per kWh required for maintenance of the electrical system.

Small residential customers face a tariff based on the number of lights and power points in the household, with three different service bands established. For consumers requiring more power, billing is linked to metered consumption. This pricing system has allowed price differences to emerge between customers supplied by SENELEC and those supplied by the concessionaires. In turn, this has led to significant tensions, particularly in concession areas bordering SENELEC's service areas. SENELEC also views the concessionaires as competitors and has not yet willingly negotiated off-taker agreements with distribution-only zonal concessionaires.

Viability and impact of Senegal's rural zonal concessions

The PPER concessionaires receive a subsidy from Agence Sénégalaise pour l'Electrification Rurale (ASER) that covers a portion of their initial investment cost. The value of this subsidy was determined in negotiations that followed the competitive public tender process. However, they do not receive a subsidy of operations and maintenance costs.

For the six concessions for which contracts have been signed, the program costs were estimated in the range of $12.67–$19.4 million (Legendre 2015). The share of private financing for the concession ranges from 22.5 percent to 67.8 percent of the total financing. ASER has pledged subsidies of $5.6–$12.4 million to each concessionaire.

The complications that have arisen can be traced to (a) the complexity of the processes used in contract negotiations and stakeholder consultations; (b) the challenges that companies face in supplying electricity through different electrification technologies; and (c) the fact that the national utility, SENELEC, has viewed concessionaires as competitors and has never signed an off-taker agreement with any of them (Mawhood and Gross 2014). Table 3.3 provides a summary of the status of the PPER concessions in Senegal.

Raising private investment resources. With respect to the leveraging of private investment, the bidding process did result in the winning concessionaires having an international partner—in contrast to the results of mini-grid bids held in Senegal and elsewhere. The negotiated contracts reveal that the share of private financing for the six currently effective concessionaires ranges from 11.4 percent to 67.8 percent, at least according to the agreement. However, with so few connections made through September 2015, it is not possible to determine how much of the expected $29 million in private investment has or will actually emerge. For that matter, it is not yet possible to discern what share of the public sector investment will emerge either.

Maintaining financial sustainability. As of October 2015, the three contracted concessionaires that had begun making connections were still in operation. The pricing formula established in the contracts by the regulator appears to allow the companies to adjust tariffs as economic conditions change. The constraint on raising tariffs may be public opinion: If customers feel that their tariffs unnecessarily exceed those of SENELEC's customers, they may voice their unhappiness.

As noted, two-thirds of the connections provided by the concessionaires to date have been solar home systems. Two reasons likely account for this. First, the installations can be made

Table 3.3. Status of rural zonal concessions in Senegal

Name	Targeted number of connections	Actual number of connections (September 2015)	Total value of concession investment ($ million)[a]	Private share of investment costs (percent)
Dagana-Podor-St. Louis (COMASEL-ONEE)	19,574	2,367	18.36	67.8
Kaffrine-Tamba-Kedougou (ERA-EdF)	18,001	1,194	13.46	36.2
Kaolack-Nioro-Fatick-Gossas (ENCO Senegal/ISOFOTON)	27,000	[b]	19.41	11.4
Kolda Velingara (ENCO Senegal-ISOFOTON)	20,500	[b]	13.61	31.0
Louga-Linguere-Kebemer (COMASEL-ONEE)	11,826	165	15.64	22.5
Mbour (SCL-STEG)	7,500	[b]	12.67	63.4

Source: Legendre (2015).

a. 1 West African CFA = $0.0017, October 2015.

b. Concession agreement became effective between November 2014 and November 2015. No connections by September 2015.

quickly, as their deployment is left entirely to the discretion of the concessionaire. To extend the grid, by contrast, the concessionaire must negotiate an off-taker agreement with SENELEC, a process that has encountered complications and delays. Second, one concessionaire in particular notes that a solar home system connection costs approximately half of the cost of a grid connection. This cost differential expands as fewer customers choose to connect to the grid. In this case, when only 20 percent of the eligible population chooses to pay the fee and connect—when 70 percent were projected to do so by ASER—the unit costs to the concessionaire run even higher, making provision of solar home systems an even more attractive option for servicing small loads in remote and sparsely settled areas.

The bias to date toward the installation of photovoltaic systems reflects badly on the relationship between the concessionaires and SENELEC, but it poses no immediate challenge to the sustainability of the concession operations. Several concessions are reportedly planning to deploy more than 10,000 solar home systems. It does, however, pose a challenge to the concessionaires' ability to supply the population in the concession areas with larger volumes of electricity for use in productive enterprises. By late 2016, the government had begun considering actions to provide further resources to enable these concessionaires to provide electricity at prices similar to those of SENELEC.

Impact. Senegal's PPER concession program has done little to accelerate the pace of rural electrification. Since the program began in 2004, it has brought access to electricity to just 3,760 customers. This result casts doubt on the processes used to establish the concession program and to identify and define the areas put out for tender.

The development of the program, including the feasibility assessments, definition of zones, preparation of bidding packages, solicitation process, bid evaluation, and negotiation of contracts took five years (2004 to 2009) before the first concession was granted. The two concessions that entered into force in 2011 had, by mid-2015, connected fewer than 2,500 customers, together, out of the estimated customer bases of 19,500 and 11,826 customers, respectively. This pales in comparison to the nearly 4 million people who gained access to electricity through SENELEC during the same period. However, SENELEC itself complicated matters by deliberately not reaching agreements with any of the concessionaires seeking off-taker arrangements in areas contiguous to the existing grid.

Lessons from solar and zonal concessions

Neither of the concessions described in this chapter yields positive lessons. The solar home system concession in South Africa faced legal difficulties in implementing the concessions; few shareholders (ESKOM or local municipalities) respected their obligations under the agreements reached. In fact, as the South African Constitution grants ESKOM sole responsible for electricity supply in the country, once it left the concession

partnership, the legal status of concessions ceased—and the obligations of stakeholders to respect them presumably ceased as well. Solar home systems are a very promising and effective technology for rural electrification in Africa. However, because concessions provide exclusive rights to natural monopolies, they do not fit well with the solar home system approach, whose dynamism as a solution depends on competition and innovation.

The zonal concession system established in Senegal made such slow progress that, even after 10 years, the connections provided were significantly below expectations. The biggest obstacle appears to have been the failure to establish clear rules of interaction between SENELEC and the zonal concessionaires with respect to power off-taker agreements and pricing. As of the time of the writing of this report, efforts were being made to resolve this impasse, in order to allow these zonal concessionaires to serve as distributors of SENELEC-generated power at a retail tariff levels comparable to the levels at which SENELEC sells power to its own customers.[15] Unless such an agreement is reached, this case will serve as a lesson on the political sensitivity of electricity pricing and the need to include reasonable pricing expectations as part of the concession regulatory framework covering not only the government and the concessionaire but also the role of the incumbent utility.

Chapter 4.
NATIONAL UTILITY CONCESSIONS

This chapter reviews all four national electrical utility concessions operating in Sub-Saharan Africa at the end of 2015: ENEO in Cameroon, CIE in Côte d'Ivoire, SEEG in Gabon, and Umeme in Uganda. The oldest of these is CIE; the youngest is Umeme. The first three firms operate as vertically integrated electric utilities, whereas Umeme is purely a distribution utility with no responsibility for generation or transmission in Uganda's unbundled electricity sector.

None of these concessions was established for the purpose of connecting more customers in rural areas. Instead, they were established to relieve government of the fiscal burden of poorly operating electric utilities. Performance indicators monitored by the government in the concession agreements normally pertain to reduction of outages and electricity losses, improved customer satisfaction, and a lighter fiscal burden for the public sector.

All four concessions have met the objectives of improving sector performance and maintaining fiscal sustainability. In addition they have, to various degrees, helped expand access to electricity despite not having this as a primary obligation.

Table 4.1 summarizes common features of the national utility concessions in Sub-Saharan Africa.

In nine other countries of Sub-Saharan Africa, the national electrical utility was concessioned at one time or another to a private company, either on a lease basis (*affermage*) or under a strict concession (table 1A.1). In all nine cases the concession was terminated early, underscoring the complexity of concessioning a national electrical utility and the delicate balance necessary to keep them operating profitably and effectively. The reasons for early termination of concessions are not well-documented. However, a few examples may shed light on the issues frequently leading to buyer's remorse.

In Cape Verde, Electra was run as a concession from 2002 to 2006. It was subsequently nationalized and the concession terminated, as a result of disagreement over raising consumer tariffs and the ambitious nature of the investment plan. In Mali, EDM was operated as a concession from 2000 to 2005. That concession was terminated because of disagreements over proposed tariff increases and ambitious investment plans. In Senegal, SENELEC was operated as a concession from 1999 to 2001. The government rejected

Table 4.1. Features common to national utility concessions

What is concessioned?	The right to operate an existing distribution grid to sell power to customers, collect revenue from customers, and extend the grid within the service area.
General obligations on the concessionaire	To provide electricity that meets specified power quality, reliability and customer service standards. To maintain the assets and hand them back in good condition at the end of the concession. To employ (most or all) of the staff of the state-owned utility.
Specific obligations related to electrification	To connect everyone within a certain distance of the grid, provided they pay the specified connection fee Often there are additional obligations related to extending the grid. These may be to connect a specified number of people in the service area (as in Gabon) or to take over and operate grid extensions financed and built by a rural electrification program (as in Cameroon).
Main sources of finance for investment	Predominantly privately financed. The owners invest equity in the concessionaire, which is usually a special purpose vehicle. The concessionaire (that is, a company set up specifically to operate the concession) also brings in commercial finance in the form of long term debt, both from commercial banks and international finance intermediaries such as the International Finance Corporation (IFC) or KfW.
How costs are recovered	Operating and maintenance costs, the cost of purchased power, and a return on capital invested are usually recovered fully through the tariff, with notable exceptions.
How tariffs are set	The concession contract or license sets out a detailed tariff regulatory regime that indexes tariffs to input prices, and allows for periodic resets to keep tariffs in line with reasonable costs of service. The tariff-setting rules may be applied by a regulator, or by another government entity specified in the concession. However, the regulator or government entity has only limited discretion, and disagreements about the tariff can usually be appealed to international arbitration.
Type and extent of subsidy	Cross subsidies toward low-use residential consumers are common. Direct output-based payments from government to cover the costs of new connections for poor households are sometimes provided. Government may build lines into new areas and hand them over to the concessionaire for operation and in-fill electrification or densification. In some cases, governments absorb part of the cost of purchased energy or fuel costs in order to reduce tariffs for all customers.
How the concessions are awarded	Through international competitive bidding.
Why governments have chosen this model	The main motivation has been to solve finance and service problems with a state-owned utility. Often this has occurred when losses at the utility have contributed to an unsustainable fiscal position.

the concessionaire's proposal to raise tariffs by 17 percent without making a counteroffer. The concessionaire responded by proposing a 5 percent increase in the tariff, only to be denied again. Following elections, the new government renationalized SENELEC, after determining that the concessionaire had not made sufficient progress in reducing power outages. Subsequently,

the government unsuccessfully ventured to once again bid out SENELEC as a concession, ultimately deciding to allow it to remain public.

Governments in five other countries in Sub-Saharan Africa seriously considered creating a concession arrangement for their national utility but ultimately rejected or abandoned the effort (table 1A.2). These cases in which governments developed "cold-feet" are even less well-documented than those cited above of agreements terminated early. In Lesotho, no private entity was willing to take over the electricity utility, so the government opted to use a management contract structure instead of a concession approach. In Madagascar, a concession agreement exists with the public utility JIRAMA. In Zambia, opposition to the set-up of a concession became so great—including especially vocal opposition from labor leaders—that the entire concession idea was abandoned.

Experience with national utilities operating under concession

Cameroon

The Cameroonian concession is known as ENEO.[16] It is similar in formulation and implementation to the other vertically integrated national utility concessions that have operated successfully for over 15 years—those in Gabon and Côte d'Ivoire.

In 1998, the government of Cameroon enacted an electricity law designed to attract private sector participation in the power sector. The law also established an energy sector regulatory agency (ARSEL) and a rural energy agency (AER). In 2001, the concession for the vertically integrated, formerly state-owned national utility, SONEL, was won by AES SONEL. The contract granted the winner a 20-year concession to operate the transmission and distribution network, and to own and operate up to 1,000 MW of generation capacity. In 2014, AES sold its stake in AES SONEL to Actis, and the company was renamed ENEO.

From 2000 to 2012, Cameroon's rural electrification rate has risen from approximately 11 percent to 18 percent. The national access rate (including both urban and rural areas) rose from 46 percent in 2000 to 54 percent in 2012. During this time, AES SONEL and its successor ENEO succeeded in extending electricity service to more than 190,000 rural households and 300,000 urban households.

At the outset, the concessionaire faced an obligation to connect new customers, which it originally met by focusing on densification of connections in urban and peri-urban areas. Over time, access targets in specific regions were set and refined. The system has evolved in such a way that the government and donors finance grid extensions through AER, and then transfer them to ENEO. In turn, this extends ENEO's service perimeter and enables it to continue to add customers through densification. Presently, some 35 percent of ENEO's one million customers are found in rural areas.

Maintaining this concession in operation has had some challenges. The concession contract has been reopened for negotiations at least three times since 2001: in 2006, in 2011, and in 2015. A

continuing area of discussion is the tariff charged by ENEO, which is relatively high by regional standards. After 2011, the government opted to freeze tariffs and to directly compensate the concessionaire by paying the difference between the frozen tariff and the tariff that would otherwise have been permitted under the concession.

The government is continuing to finance and build grid extensions into rural areas, and continuing to hand over the newly built lines to ENEO. It has also been trying, mostly unsuccessfully, to attract private sector participation in projects outside the ENEO concession area. As noted previously, efforts to establish mini-grid concessions for remote rural electrification using renewable energy (including hydropower plants up to 5 MW) have not been successful, partly because the proposed tariffs exceed the ENEO tariff by a margin that is considered politically unacceptable.

ENEO is performing satisfactorily with respect to its obligations to improve operational efficiency, reduce losses, expand the network where appropriate, and maintain fiscal sustainability.

Côte d'Ivoire

The government of Côte d'Ivoire selected a concessionaire to operate its vertically integrated electric utility in 1990. After winning the competition for this *affermage* contract, the *Compagnie Ivoirienne d'Electricité* (CIE) operated the sector through the first 15-year concession period (which ended in 2005) and is now two-thirds of the way through a second period, which runs to 2020. CIE has been credited with maintaining reliable electricity supply even in the recent period of political instability. The primary shareholder of the CIE concession, Eranove, operates several public utility concessions and an independent power company in Central and West Africa.

CIE has not been given access targets as part of its concession agreement. The electricity access rate in Côte d'Ivoire has remained fairly steady, rising from 51 percent of the population in 2000 to 56 percent in 2012. The rural access rate remains low, at an estimated 29 percent (World Bank and IEA 2015). In 2016, the government expressed renewed interest in expanding electricity access into rural areas, and CIE has expressed its willingness to cooperate in this effort.[17]

Gabon

The government of Gabon issued a 20-year concession for its *Société d'Energie et d'Eau* (SEEG) in 1997 (IFC 2010). The winning bidder proposed a 17 percent reduction in the combined tariffs for water and electricity service. The terms of the contract allow the concessionaire to adjust its tariffs on an annual basis, with the exception of social tariffs, which are allowed to rise by no more than 1 percent annually (Tremolet 2002).

Unlike in the other cases, Gabon had spent a decade preparing the ground for this successful concession by raising tariffs to sustainable levels and placing SEEG on a sustainable financial and operational footing before the concession solicitation was initiated. Good preparation is a major

reason why the concession arrangement has been maintained for nearly 20 years.

Early experience was positive. The concession contract established target electricity and water connection rates for the four major urban networks in Gabon for the year 2000. The newly concessioned SEEG managed to exceed these targets for the four largest cities. In isolated centers with access rates of 33 percent in 1993, SEEG managed to connect 89 percent of possible customers by 2000. The only initial connection target that was not reached by 2000 was for isolated centers with no electricity service; these remained without electricity in 2000.

Following an amendment to the concession contract in 2006, sector investment responsibilities are now shared between the government and SEEG, which have agreed that "structural investments" specifically designated by mutual agreement (investments in generation, transmission, and distribution, whose lifespan exceeds the term of the concession contract) are the government's responsibility. The concession perimeter extends 400 meters on each side of the existing network, and as the network expands, so does the concessionaire's area of responsibility (World Bank 2015).

Poor households whose consumption falls below a lifeline level and are formally considered as low-income Gabonese receive free electricity, subsidized by the government at a cost of approximately $2.5 million per year. Current estimates place the number of unelectrified rural villages at more than 3,000. These rural areas are considered to be outside of SEEG's service area. From 2000 to 2012, the nationwide electricity access rate rose from 74 percent to 89 percent. About a thousand localized electrical systems or networks (mostly PV-powered solar home systems) are found in the rural areas not served by the grid.

Progress toward universal rural access remains slow, with only 45 percent of the rural population having access to electricity (World Bank and IEA 2015). The initial progress of the concessionaire to connect customers within its service area has continued, with the result that urban areas have an access rate of 98 percent. The SEEG concession agreement will expire in 2017 and will likely be extended or re-bid (African Energy 2015).

Uganda

Uganda's national distribution utility concession differs from the other three cases as it operates in a common law country. Furthermore, it represents a case in which the distribution utility was put out for a concession contract in an unbundled electricity sector.

In 2004, following international competitive bidding, Uganda's main state-owned distribution grid was contracted out for 20 years to Umeme Ltd, a private consortium comprising Eskom, Globeleq, and later Actis. Its primary objective was to relieve the government of the fiscal burden of the electricity sector while reducing system losses and increasing collections. A complex package of funding was assembled by the World Bank, the Multilateral Investment Guarantee Agency, Citibank, Eskom, and Globeleq to enable the initial

lease payment to the owner of the distribution network, Uganda Electricity Distribution Company (UN Economic Commission for Africa 2011). Increasing electricity connections in rural areas beyond the concession zone was not one of the objectives set for the concessionaire. In October 2012, Umeme held an initial public offering, floating nearly 40 percent of its shares on the Uganda Securities Exchange.

When Umeme took over operations of the grid in 2005, the network comprised a total of 290,000 connections. Umeme's concession area was defined as the existing lines and the area within one kilometer on either side of the existing distribution network. In the years before the creation of the concession, the state-owned utility had been slowly expanding the grid in both urban and rural areas. Therefore, Umeme's concession area contained rural infrastructure that was not being effectively exploited. Umeme took over the assets and began adding connections within its service area.

The Umeme concession has been successful in terms of improving the performance of the Ugandan electricity distribution network. It has also been successful in connecting rural businesses and households to the grid. It maintains control of about 95 percent of the country's distribution network. One isolated mini-grid concession (WENRECo, described in chapter 2) accounts for approximately 6,800 connections, and five other small distribution concessions account for another 31,600 connections.

According to Umeme managers, approximately 30 percent of Umeme's total connections are now in rural areas. These connections typically fall within the one-kilometer concession boundary from the existing grid. As of mid-2015, total connections had grown to 650,000, an increase of 124 percent over 10 years. Roughly 120,000 of the additional 360,000 connections made by Umeme are located in rural areas. Overall, Uganda's energy access rate rose from 9 percent in 2000 to 18 percent in 2012 (IEA and World Bank 2015).

The main distribution grid has attracted considerable private finance since Umeme took over operations. Actis paid a transaction fee of $1.4 million to the government when the assets were transferred. In 2009, Umeme signed a $25 million loan agreement with the International Finance Corporation. In 2012, Umeme held an initial public offering, raising about $28 million in new capital from the issuance of primary shares. Finally, in 2013, Umeme raised another $170 million in external financing for capital improvement projects through 2018. As of 2014, Umeme's total borrowings were $265 million.

Umeme has been successful in raising capital for investment in the distribution network. It has also succeeded in reducing system losses from 38 percent in 2005 to 21 percent in 2014, and in increasing collections from 80 percent to 99.1 percent over the same period.

To quicken the pace of rural electrification, the Ugandan Rural Electrification Agency has started to subsidize the construction of new, rural feeder lines because it is not profitable for private entities to do so. It has also begun to build new distribution lines and lease them out

to local concessionaires or cooperatives. The provision of these networks—which may overlap with Umeme's service area—to new actors in the electricity sector shrinks the potential cost savings in administration and management that would be available if these same lines were leased to Umeme.

Viability and impact of national utility concessions

Raising private investment

All four of these national utility concessions have successfully raised private sector finance—equity and debt—to achieve their objectives. In Cameroon, AES originally paid the government of Cameroon $71 million for a 56 percent stake in SONEL. In 2006, it received €240 million in loans from development finance institutions, including the African Development Bank and the International Finance Corporation. In 2009, AES sold its shares in AES SONEL to Actis for €220 million. In the case of Gabon's water and electricity concession, Veolia invested more than $690 million in the company between 1997 and 2014.[18] In Uganda, Umeme raised roughly $28 million in private capital from its initial public offering in 2012 and then obtained a private loan of $190 million in 2013, considered the largest private loan ever made to a Ugandan firm.

These national utility concessions have been able to raise private funding to ensure successful utility operation. Only a small fraction of the total is directed to rural electrification, as these concessions were not designed to expand connections into rural areas but only to connect customers within the boundaries of existing service areas. In Cameroon and, to a lesser extent, Gabon, funds from donors or governments have been used to expand the grid's reach into rural areas, thereby increasing the concessionaire's reach.

Maintaining financial sustainability

A second objective of all four national utility concessions was to relieve the fiscal burden on governments of underperforming electric utilities. Achieving that objective has required three actions over the concession period: a reduction in system losses, an improvement in collection rates, and an ability to recover the costs of electricity by adjusting tariffs. To date, all four of the African national utility concessions appear to be maintaining financial sustainability. That is not to say that there are not episodes of difficulty brought on by fuel-price spikes, regulatory or contractual disagreements, or even national security issues. But in all four cases, the concession has maintained a healthy financial status.

The performance of the national utility concessions has been found satisfactory by the host governments, as evidenced by the fact that they continue to operate. Performance metrics have been met and, in spite of potential political opposition, tariffs have been maintained at a level sufficient to cover the costs of electricity supply.

The case of ENEO in Cameroon is unique in this regard, as the government pays ENEO the difference between the agreed cost of supply and the tariff charged. Gabon's decade-long preparation for the adoption of the concession,

during which customers adapted to paying cost-recovery tariffs, has served the country well, as the population has become accustomed to paying the cost of supply, and the government is able to focus its attention on paying the electric bills of the poor.

Over its concession period, Umeme has managed to gain approval for raising the electricity tariff from $0.05/kWh in 2005 to $0.16/kWh in 2015. CIE has been operating the national utility in Côte d'Ivoire for 25 years and has been able to operate at a profit, continuing to supply power even through the politically difficult years from 2008 to 2010.[19] In fact, ENEO,[20] SEEG (African Energy 2015), and Umeme (2014) all declared profits in 2014, indicating that their profitability goal was being met for at least that year.

Impact

All four of these national utility concessions have been operating for at least a decade and have faced tariff rises and renegotiated elements of their initial concession agreements. One has even been renewed for a second 15-year concession term. Whatever their original performance metrics, the four concessionaires have met them well enough to stay in business.

None of these concessions was established with a primary objective of increasing rural access to electricity, but three of the four concessions have shown an ability to increase access to electricity within the concessionaire's designated service areas. In Cameroon, ENEO (and its predecessors) have added an average of about 40,000 connections per year and succeeded in raising the number of grid connections by 570,000, of which 190,000 are in rural areas. In Gabon, SEEG has added roughly 10,000 new connections per year, raising the national access rate to 89 percent and the rural access rate to 45 percent. Umeme averaged 30,000 new connections annually from 2005 to 2014, peaking with 78,000 new connections made in the final year of this period. Altogether, Umeme has increased connections by a total of 360,000, of which roughly 120,000 are in the rural areas. CIE is the only one of these four utility concessions that has not yet achieved significant increases in rural access.

Prospects for national utility concessions in rural electrification

Only four companies in Africa have successfully developed concession arrangements for the management and expansion of the national distribution utilities. All four have demonstrated a willingness to be constructively involved in expanding energy access and have continuously engaged with the concessionaires.

Moving forward, the challenge is to reach agreements whereby the strengths of the concessions are brought to bear on expanding rural access without compromising the primary goal of improving utility performance. Perhaps the simplest way to do this would be to negotiate a specialized set of agreements related to rural electrification within the overall concession framework agreement. This subset could include cost-sharing arrangements between the government and concessionaires or government

guarantees of loans to the concessionaires for grid extensions not expected to contribute immediately to the health of the concessionaire's short-term balance sheet. Such arrangements might be the most direct way of harnessing the financial strength of these relatively large actors to play a greater and more constructive role in expanding access to electricity in rural areas.

Chapter 5.
LESSONS FROM OTHER REGIONS

The previous chapters have focused on electricity concessions in Sub-Saharan Africa. Outside the region, other countries have used concessions to achieve near-complete electrification, while others have successfully used alternative approaches. This chapter presents a few successful examples from Asia and Latin America that may be useful to bear in mind when pondering concessions in Sub-Saharan Africa.

Mini-grids in Sri Lanka and Cambodia

Under the World Bank–supported Energy for Sustainable Development project, which ended in 2002, 35 village hydropower schemes were built in Sri Lanka. With a total capacity of 350 kW, the schemes benefitted 1,732 households.

Based on the success of the program, these schemes were expanded in the subsequent Renewable Energy for Rural Economic Development (RERED) project. This project, which ended in 2012, deployed additional village hydro systems to electrify approximately more 6,000 households.

No major issues were reported during the implementation of the village hydro component of the RERED project. The capability and technical capacity of some of the developers and equipment suppliers posed a minor challenge that was addressed through the introduction of a prequalification process, mandatory testing of equipment, and stricter supervision.

One key to the success of the project lay in the management practices of the Sri Lankan DFCC Bank, which functioned as RERED's administrative unit (AU). In effect, the AU was both a regulator and a promoter, acting as a *de facto* rural electrification agency. Other power sector entities essentially allowed the AU to carry out the project alone, perhaps because it did not encroach on their turf and did its job successfully, or possibly because the AU was being closely supervised by the World Bank.

By design, the AU was established as a separate entity from DFCC Bank's main lending function in order to avoid a possible conflict of interest and to provide transparency to other banks that were competing with DFCC Bank to refinance sub-loans. The AU was staffed with professionals (including engineers), many of whom had gained considerable experience from the implementation of the earlier Energy for Sustainable Development project.

A typical village hydro scheme had approximately 10 kW of capacity and provided electricity to about 40 households, each receiving approximately 250 W of power. This generally proved sufficient to light an average home with several compact fluorescent bulbs and to operate small

appliances, such as a small TV set or a radio. While household electricity supply was the primary purpose of a village hydro scheme, additional benefits accrued through productive use of electricity by small businesses, particularly during the day, when household demand was low.

From the days of the Energy for Sustainable Development project, each village hydro project was implemented, owned, and maintained by a village-based electricity consumer society. Potential project developers received a grant to develop the projects. This grant was paid in installments as agreed milestones were reached. The lure of support brought an increase in the number of village hydro developers, some of whom lacked the required knowledge and skills, during the latter stages of the Energy for Sustainable Development project. To avoid this, the RERED project introduced a prequalification process under which only developers and equipment suppliers with a minimum level of knowledge and experience could receive project-development grants. This reduced the number of incomplete projects and dissatisfied end users. Mandatory testing of turbines prior to installation improved the quality of equipment and reduced conflicts with suppliers.

A typical village hydro scheme was financed through a combination of bank loans (approximately 35 percent), equity from beneficiaries (approximately 18 percent), and grant support from RERED (approximately 29 percent) and provincial councils (approximately 18 percent). Equity from beneficiaries comprised a cash contribution and *shramadana* or sweat equity (measured as the cash equivalent of construction labor). The project provided loan financing, grant support, and technical assistance to the electricity consumer societies.

Each successfully completed village hydro scheme received from the Global Environment Facility a co-financing grant of $600 per kW of installed capacity. Grant assistance to village hydro projects was also provided by provincial councils under their decentralized budgets.

The Sri Lanka village hydro projects were not formal concessions but schemes run by local people who formed a society to own and operate their power system. In this effort, they received significant financial assistance from the government and other external agencies. However, the conditions for transitioning from the mini-grids to the main grid were never formalized or even clearly defined.

When the main grid eventually arrived, many households opted to switch to grid-based electricity, neglecting the local generation assets. In certain cases, the villagers continued to operate the village-hydro scheme in parallel to the grid connection, primarily with the aim of reducing their grid electricity consumption. However, such schemes were not formally regulated or maintained, and they eventually ceased to function. It is true that the abandoned assets were relatively low in value and by then had already served a significant function. At present, only a few village hydro schemes remain in operation. But while they operated, the village mini-grids provided reliable electricity to villagers at affordable prices—and that can be considered a success.

Several aspects of the Sri Lankan experience were keys to success. In many of the villages, the people had experience in organizing themselves to achieve a social goal. There was also a nascent "credit culture," under which villagers were used to repaying loans. And the banking sector was mature enough to embrace small loans under the banner of corporate social responsibility.

Finally, the fundamentals of the power sector and of the economy as a whole were stronger in Sri Lanka than they are in most Sub-Saharan African countries. In order to ensure the success of the two village hydro projects, experienced consultants were hired to assist the village developers, and a dedicated agency (the AU) was set up to manage the RERED project. As a result, the mini-grids offered a reliable and sustainable option for Sri Lankan villagers in anticipation of the arrival of the main grid.

Cambodia has developed a franchise model of mini-grid distribution that has connected more than 250 formerly isolated mini-grids to the national grid as "distribution licensees." The franchisees (private companies) purchase electricity at wholesale prices and resell it to retail customers through their distribution networks. As of late 2015, the country also had 40–45 isolated mini-grids.

In March 2016, the government of Cambodia and the Electricity Authority of Cambodia introduced a comprehensive program to lower the retail tariffs charged by these distribution franchises to standard levels, with the difference between them and the franchisees' costs covered by cross-subsidies provided by the national utility, Electricité du Cambodge.

In addition to tariff standardization, the program also encompasses tariff reduction for customers connected to the national grid. Thus, while the retail tariff for distribution franchisees before the program ranged from 1,000 to 1,250 riels per kWh ($0.25 to $0.30 cents), since March 2016 it has been set at 800 riels per kWh for domestic metered consumption and 420 riels per kWh for residential consumers requiring less than 10 kWh. It is too early to tell whether this arrangement will remain viable.

Solar home system concessions: Argentina's PERMER

Starting in 1998, Argentina began to encourage the development of small rural electricity concessions to deploy off-grid systems to reach remote households, businesses, and government buildings. Argentina was largely electrified at the time (> 90 percent access), and the remaining settlements requiring electricity service were very remote and extremely expensive to connect to the grid.

Between 1999 and 2012, the government obtained support from the World Bank to implement this rural energy strategy under the *Proyecto de Energías Renovables en Mercados Rurales* (PERMER).

The government chose a private concession approach to provide the necessary off-grid services, intending that private entities seek concessions would be willing to invest significant

amounts of private capital to install and operate the systems, recovering their investment and operating costs through fees and tariffs.

However, the private sector was not convinced that acceptable returns could be obtained from these "last-mile" connections using solar home systems. As a result, the expectations for private investment and return were lowered. Instead, donors and the government provided almost all of the up-front capital. The concessionaires were required to install, operate, and maintain the systems using a fee-for-service model. They were also responsible for collecting a regulated tariff from users. Provincial governments subsidized some or all of this tariff, with the subsidy varying from 10 percent to 100 percent of the total depending on the province and the location within the province.

The original financing plan for the off-grid concessions called for private concessionaires to contribute $43 million, or 36 percent of the total project costs. However, the economic crisis of 2001 led to the abandonment of the private financing approach. Public entities and cooperatives were allowed to participate as concessionaires, and the World Bank increased its financing contribution to the projects. Ultimately, the private concessionaires contributed $0.61 million, or approximately 1 percent of the actual project costs. In 2008, five private concessionaires were offering off-grid energy services; by 2012, the number had increased to eight. However, these companies were assuming less operating risk and investment risk than was originally intended.

Argentina's off-grid program succeeded in electrifying 25,000 rural households, or approximately 100,000 people, mostly using solar home systems. This fell well short of the original target of 65,000 solar home systems. The difference is explained by the reduced contributions allocated to the project by local sources, especially private capital.

The Argentine experience appears to have two implications for the implementation of such programs in Sub-Saharan Africa. First, the case highlights the importance of adopting a flexible, open-minded, and goal-oriented approach. Even though the original means identified to reach the goal of electrifying the remote areas was shown to be unrealistic, the goal was (partially) achieved through a changed delivery.

Second, the provision of electricity service to the most remote areas of the country can be achieved using solar technology, whether or not expectations of significant private sector investments prove realistic. Argentina, an upper-middle income country, increased the government's contribution so that the remote access was eventually provided without the private sector contribution. Lower-income countries may not have that level of financial flexibility.

National utility concessions: Peru and Guatemala

Experience from Latin America, notably Peru and Guatemala, demonstrates how the concessioning of a national utility can be combined with the goal of increasing connections.

In Peru, the government pays the bulk of the costs of extending the grid into new areas, but as the grid expands, the areas managed by concessionaires expand as well. Through the combination of government-financed grid extension and concessionaire-financed customer connections, utility concessions in Peru connected more than 700,000 households to the grid between 2004 and 2013, raising the national electricity access rate from 26 to 70 percent.[21]

In Guatemala, the government used receipts from the sale of two distribution concessions to establish an electrification fund that was used to create a scheme under which concessionaires were required to connect all customers within their 200-meter service area. For those living outside that area, the concessionaire was provided a grant of $650 for each connection made. The scheme contributed to raising the national electrification rate from 64 percent in 1998 to 90 percent in 2004 (Harris 2002).

These examples show that national utility concessions can be effective at increasing rural access to electricity, provided the government demonstrates a firm commitment to pay a significant share of the costs of expanding grid infrastructure into rural areas. This strategy has not been tried by any of the national utility concessions now operating in Africa. Cost-sharing and a mandate from the public side of the partnership may be necessary if national utility concessions are to increase rural access.

Main lessons from other regions

Concessions may have been helpful in increasing rural access to electricity in Latin America; in Asia, they played virtually no role. In Sri Lanka and Cambodia, local initiatives—from both the community and entrepreneurial sides—helped provide basic electricity when the government was unable to do so. In neither case were concessions deployed.

In the Latin American cases reviewed, concessions proved useful, albeit not necessarily in leveraging large sums of private financing. The Argentina case is instructive, as the concessions deployed under PERMER were tasked with truly "last-mile" electrification, which is very costly. Given the remoteness of the communities and limited demand for electricity, expectations about private sector contributions were not met. Although private investment was not attracted, the private sector did provide the services and connections needed to provide service to these last, unelectrified communities at a time when the national utilities were not able to do so. Concessions also proved useful in Peru and Guatemala, but it neither involved a turn-key solution that the government (either national or local) could walk away and leave to self-manage. Governments remained involved and committed to working with the concessionaires in order to help them increase access in remote communities.

CHAPTER 6. THE CONTRIBUTION OF CONCESSIONS TO RURAL ELECTRIFICATION

This report has reviewed experience with the use of four different concession models—mini-grids, solar home systems, zonal concessions, and national utility concessions—to expand rural electrification in Sub-Saharan Africa and elsewhere. Our goal has been to help countries grappling with rural electrification to decide whether a concession approach may be appropriate and to design an effective framework for concessions. Table 6.1 summarizes the experience of concessions in Sub-Saharan Africa in terms of the conditions outlined in Chapter 1.

Of the cases where electricity concessions have been prepared for implementation in Sub-Saharan African countries, more have failed (during preparation or implementation) than have been implemented (see the annex to chapter 1). Of those implemented, none can be considered an unequivocal success. The discussion that follows outlines the more promising opportunities and initiatives and draws lessons that can be used to make concessions a more effective and better-defined tool for bringing private resources to bear on the vast electrification challenge facing Sub-Saharan Africa.

Mini-grid concessions

The mini-grid concession model can contribute real value to the electrification of rural areas in Africa. In the cases that were identified and studied in this report, mini-grid concessions have brought local private financing into an arena that has in the past been financed solely by public means. In itself, that is a significant gain. Stronger designs and clearer planning of concession arrangements may make it possible to increase the share of financing raised from the private sector. Beyond financial leverage, other benefits from such an arrangement include increased responsiveness to local service challenges, more efficient and effective management, and greater local ownership and participation.

Given an enabling regulatory and policy environment, mini-grid concessions can successfully co-exist with and complement the national grid, providing affordable electricity service to those not yet reached by the grid. If properly structured and incentivized, concession arrangements can offer economies of scope to mini-grid operators and enable them to make up a significant share of the overall rural electrification effort.[22]

Failure to adhere to two of the conditions outlined in table 6.1—consistency of rules and financial viability—created problems with mini-grid concessions in several countries.

Mini-grids have been key to the rapid growth of rural electrification in several Asian countries, such as Sri Lanka and Cambodia. However, the circumstances of these cases differed in key respects from those obtaining in most of Sub-Saharan Africa. Moreover, most of the cases emerged without the protections provided by a legal concession structure.

The analysis in this report identified the following advantages and disadvantages of the mini-grid concession model:

Advantages

- Mini-grids are a technically and economically optimal solution in some areas, particularly when connecting small and geographically remote settlements over the short to medium term.
- Mini-grids often tap market forces, engaging local entrepreneurs and business leaders willing to invest in them to serve their communities.
- Mini-grids develop local entrepreneurial talent and local solutions, with local operators having a good understanding of local challenges and strong incentives to reach commercial viability in order to serve their neighbors' needs.
- Mini-grids attract private sources of financing from local sources. Although these private resources often represent a small share of the total investment cost, they supplement the limited public resources available for rural electrification.

Disadvantages

- Owners/operators often lack capital, because the local businesses and entrepreneurs who are best positioned to undertake mini-grid projects have limited access to debt and equity.
- The financial viability of mini-grid concessions can be marginal, as local concessionaires have proven unable to recover from customers the high upfront capital costs of tapping renewable generation sources or the costs of unforeseen increases in expenses, such as diesel fuel costs.
- Future integration with the grid is often not adequately planned for, with concession guidelines frequently not explicitly stating the technical standards and the compensation formula for the anticipated fold of the mini-grid into the main grid.
- Planning for mini-grid bidding has not yet attracted large international investors, who could operate multiple mini-grids in the same country and thus take advantage of economies of scope. With recent advances in geospatial analysis, governments should be able to identify and bid out multiple sites ripe for mini-grid concessions.

Table 6.1. Necessary conditions for concessions: Examples from the case studies

Category of concession	Regulatory				Financial		
	Clarity of roles	Consistency of rules	Flexibility over time	Compliance	Pre-investment support	Financial viability	Timely disbursement of funds
Mini-grid concessions	Several cases demonstrate lack of clear legal responsibilities for both partners under the PPP framework, if one was adopted at the time of the concession's establishment. (–) Uganda: WENRECo's responsibilities and terms were not fully clarified from the outset of the project.	(–) Madagascar: government did not pay universal access subsidy as all funds were devoted to a poorly managed incumbent utility, Jirama (–) Uganda: WENRECo to be connected to the national grid in 2019, 5 years before the end of the concession period, with weak definition of responsibilities.	(–) Uganda: WENRECo's completion of a diesel plant allowed it to maintain service, but necessary tariff increases were not negotiated until the Nyagak small hydro was completed in 2012, despite financial duress faced by WENRECo.	No compliance burden problems were identified by the study within reviewed mini-grid concessions.	(+) Mali: The government of Mali provided 75 percent of mini-grid capital costs as grants.	Most governments provided at least some public funds to promote financial viability. (–) Madagascar: During the concession period, the government removed the diesel subsidy, which formed the basis for most concessionaires' generation. As a result, 17 concessionaires stopped operating.	No issues with timely disbursement of funds for mini-grid concession financing were identified by the study.
Solar home system concessions	(–) South Africa: The roles of the national utility and local authorities were not clearly delineated.	(–) South Africa: Eskom never fully bought into the arrangement and extended grid into concession areas, undermining concessions.	(–) South Africa: The rules were not modified during the concession period in spite of changing sector and industry conditions.	(+) South Africa: The compliance responsibility placed on the concessionaires was reasonable and measured.	(+) South Africa: Pre-investment support provided to the concessionaires was acceptable and played a significant role.	(–) South Africa: The financial viability of concessionaires was a concern but not implemented in a workable manner.	(–) South Africa: The public funds for energy payments were not made available in a timely manner.

(continued)

Category of concession	Regulatory				Financial		
	Clarity of roles	Consistency of rules	Flexibility over time	Compliance	Pre-investment support	Financial viability	Timely disbursement of funds
Rural zonal concessions	(–) Senegal (PPER): Not all roles were clearly defined, particularly those of the main utility, SENELEC, and its relationship to distribution concessionaires.	(+) Senegal (PPER): There appears to have been consistency in the rules.	(+) Senegal (PPER): There was evidence of flexibility in the course of implementation - some terms of bidding were revised and renegotiated.	(–) Senegal (PPER): The definition of the rules was cumbersome, and not all the actors had a clear understanding of how to comply.	(-) Senegal (PPER): Pre-investment support through the bidding process was self-corrected. Bidders did not respond to earlier bids, lengthening the procurement and enrollment period.	(–) Senegal (PPER): The distribution-only concessionaires were unable to purchase or produce reasonably priced electricity from SENELEC.	(+) Senegal (PPER): public funds, where called for, were provided on time and posed no obstacle.
National utility concessions			(+) Cameroon: Concessionaire accepted new distribution areas, thereby increasing its service areas in increasingly rural areas. (–) Uganda: Umeme could have operated new rural distribution networks but were not selected to do so, reducing potential economies of scale.		(+) Gabon: Concession implementation was preceded with a ten-year period wherein cost-reflective tariffs became the rule (also relevant for financial viability).	(+) Cameroon: The government agreed to pay electricity cost increases rather than have them passed along to consumers, ensuring SEEG's viability and political acceptance.	

Note: "(+)" signifies positive example; "(–)" denotes negative example

Based on the review of the mini-grid concessions, this study makes the following suggestions to improve their design and implementation:

- Improving access to outside financing, particularly longer-term financing, is key to providing mini-grid start-up operators or concessionaires with sufficient working capital to maintain affordable tariffs.
- Providing significant subsidies to bring mini-grid systems to financial viability is vital in overcoming the lack of ready financing and the limited willingness and ability to pay found in many rural communities.
- Implementing tariffs that promote financial viability and allowing mini-grid operators to adjust prices as needed, through tariff hikes or recurrent subsidies, will ensure that mini-grid concessions meet the risk-reward requirements of potential investors.
- Developing a regulatory transition path for mini-grids to reach utility scale and connect to the national grid is fundamental in promoting the long-term financial stability of operators.
- Encouraging common ownership/management of several mini-grids will help operators take advantage of economies of scope and potentially reap significant savings in administrative functions, engineering design, and repetition.

Concessions of solar home systems and zonal concessions

In Sub-Saharan Africa, concessions of solar home systems have been undertaken only in South Africa, and the experience is not regarded as a success. The reasons most commonly cited for its failure are the following:

- **Lack of tariff subsidies.** The South African authorities did not pay the tariff subsidies they were required to provide to the solar companies.
- **Lack of exclusivity.** The concession agreements conferred no legal right of exclusivity to the concessionaire, with the result that the national utility, Eskom, could offer grid electricity to consumers in the concession area without paying any compensation to the concessionaires. Once offered access to grid power, many customers chose to breach their payment obligations to the concessionaires, leaving several facing bankruptcy.
- **Lack of a natural monopoly.** Solar home systems remain a very dynamic market, relying upon technological innovation, differing service levels, and cost competition. Together, these factors mean that markets for solar home systems are not geographically defined natural monopolies and thus are a suitable fit for concessions.

Concessions for deploying solar home systems in remote rural areas far from the national grid have also been attempted in Argentina, where, despite early hopes and intentions, little private funding materialized. The government of Argentina ultimately paid the full costs of the systems, but the program's design may have been unrealistic in expecting "last mile" electrification to be an attractive business proposition for private concessionaires.

The zonal concession model has been attempted only in Senegal. Although the scheme continues to operate, its progress has been limited. The key lessons gleaned from this review of the model are as follows:

- Design and implementation time were too lengthy. Work on the concession model began in 2004, but implementation of feasibility assessments, definition of zones, preparation of bidding packages, solicitation process, bid evaluation, and negotiation of contracts took five years before the first concession was granted in 2009. By the end of 2015, only 3,760 connections had been made, approximately two-thirds of them through the installation of solar home systems.
- Clarity on coordination with the national utility was lacking. The presence of the program appears to have induced the national utility, SENELEC, to step up its electrification efforts: The national electrification rate increased by 115 percent between 2000 and 2012. But the implicit competition between SENELEC and the concessionaires, and SENELEC's resistance to reaching off-taker agreements with concessionaires in areas contiguous to the existing grid, has made it next to impossible for concessionaires to purchase power from SENELEC, leaving their proposed mini-grid distribution networks without power. This obstacle did result in progress in the deployment of solar home systems within the concessionaires' service areas. When unable to purchase power from SENELEC, these zonal concessionaires deployed solar home systems as the quickest and cheapest way to achieve their basic service obligations, despite the limitations of solar home systems in terms of cost, capacity, and time of day. Although several concessions are reportedly planning to deploy more than 10,000 solar home systems, the technology choice poses a challenge to the concessionaires' ability to supply the population in concession areas with larger volumes of electricity for use in productive enterprises. To address this constraint, by late 2016 the government of Senegal had begun considering actions to provide further resources to enable these concessionaires to provide electricity at prices similar to those of SENELEC.

National utility concessions

National utility concessions have been considered in many countries in Sub-Saharan Africa, generally as part of utility reform processes. Many of those considered were never implemented. And of those implemented, only four remain in operation: ENEO in Cameroon, CIE in Côte d'Ivoire, SEEG in Gabon, and Umeme in Uganda. The evidence presented in this report

suggests that these concessions have been effective at electrifying areas within a defined service area surrounding the existing grid, but have had a mixed record in expanding connections beyond those service areas. Where governments have engaged with concessionaires to increase electricity access beyond their service areas, the latter have responded favorably and cooperatively, helping rural populations gain access to grid electricity.

Elsewhere in the world, national utility concessions are most common in Latin America. In the two cases discussed in the report—Guatemala and Peru—the concessions, one public, one private (with public support), have increased rural access significantly. In Peru, concessioned utilities connected more than 700,000 customers to the grid, increasing the rural electrification rate from 26 percent in 2004 to 70 percent in 2013. In Guatemala, the government set up an electrification fund using the proceeds from sales of two distribution concessions that helped boost the national electrification rate from 64 percent in 1998 to 90 percent in 2012.

The report draws several key lessons about national utility concessions:

- National utility concessions are not designed primarily to widen rural access to grid power, but they can support extension of electricity access to rural areas. While none of the national utility concessions examined in the report was established with the primary objective of increasing rural access to electricity, three of the four concessions increased access to electricity within the concessionaire's designated service areas. They were able to encompass improving access within or near the existing grid alongside their chief role of reducing financial and physical losses while increasing the operational efficiency of the utility. In Uganda, for example, Umeme's experience has demonstrated that a national utility concession can be very effective at increasing access within its defined service area. In Cameroon, the government has built distribution networks in previously underserved areas before turning the new networks over to ENEO to include in its service areas; ENEO then becomes responsible for making new connections. In Gabon, SEEG added roughly 10,000 new connections per year, raising the national access rate to 89 percent and the rural access rate to 45 percent. In short, where provisions are made to extend the grid (through cost-sharing or government guarantees for grid-extension loans) utility concessions can become capable and cost-effective partners in increasing access to electricity among rural populations.
- Government involvement is key to ensuring successful functioning of national utility concessions. The national utility concessions examined in this report did not encounter significant problems with any of the conditions displayed in table 6.1, possibly because they were carefully designed. The same care would be needed in any future concessions that may have rural electrification as one of their objectives. Fortunately, utility-scale concession models and agreements from around

the world are available for consultation. One element favoring the use of national utility concessions as an instrument of rural electrification is that the national utility is nearly always important enough to demand government's attention when issues need resolving. Even so, national utility concessions do not always survive in Africa: nine such concessions have been terminated after just a few years of operation (see table 1A.1).

The key challenge to ensuring success of national utility concessions is reaching an agreement between the public sector and the company whereby the strengths of the concessions are harnessed to expand rural access without compromising the primary goal of improving utility performance. This report proposes that the most appropriate approach to achieve this is the explicit stipulation of a specialized set of agreements or clauses covering rural electrification within the overall concession framework agreement may be the most appropriate and direct approach to harnessing the financial strengths of these private actors. The clauses would be expected to cover potential cost-sharing arrangements between the government and concessionaires, or alternatively offer government guarantees of loans to the concessionaires for grid extensions not expected to immediately contribute to the concessionaire's short-term balance sheet.

Concluding remarks

This report has reviewed electricity concession arrangements in Sub-Saharan Africa during a period when electrification lagged behind population growth. As African populations, governments, and the international community place greater emphasis on universal electrification, the pressure will grow to find ways to tap private investment and expertise to meet the challenge—notably through mini-grids. As part of this process, concession arrangements that reflect the lessons identified in this report will play an important part in stimulating public-private cooperation in the service of universal access to electric power.

Concessions have proven themselves useful in improving utility performance and in eliciting private investment in the development of mini-grids in several African countries. At the same time, some national utility concessions have proved able to adapt their operations to expand electricity service to customers beyond their original service areas. In general, where governments and national utility concessions have a good working relationship, they have been able to negotiate terms sufficiently favorable to concessionaires to encourage them to extend service deeper into the rural areas.

This review has shown that concessions in different forms can serve as useful public-private instruments to accelerate rural electrification beyond the range of what either partner—public or private—might be expected to accomplish on its own.

If properly conceived and implemented, concessions provide a legal structure for effective functioning as a public-private-partnership in the electricity sector. Of couse, they do not alter the fundamental economics of rural electrification or reduce overall costs; rather, they provide opportunities to bring private resources to bear. What should be clearly understood is that concession arrangements are not an end in themselves, but a means to provide incentives and protections that can attract private resources and expertise to the challenge of accelerating electrification in rural Africa.

Advances in electrification planning made possible by geographic information systems will allow mini-grid concessions to be designed so that they afford greater economies of scope and cost-recovery tariffs. Simultaneous advances in renewable energy technology—especially solar photovoltaics—have multiplied the options for generating power in rural areas. Through GIS, through stand-alone solar home systems (likely under conditions of competition rather than concession), and through cost-reducing hybridization of mini-grid generation, rural electrification is evolving rapidly, making it easier to plan and manage and more appealing to public and private investors alike. Concessions can be a useful option for attracting private resources and expertise to address the enormous challenge of rural electrification, but interested governments need to be prepared to actively engage in their implementation, setting an overall regulatory framework and lining up appropriate incentives to bring in and retain the private sector.

NOTES

1. The six case study countries were Cameroon, Madagascar, Mali, Senegal, South Africa, and Uganda. In addition, a brief review was done on the case of Burkina Faso, where the concession arrangement is unique, as the concessionaires are cooperatives rather than private companies.

2. In nine other countries of Sub-Saharan Africa, the national electrical utility was concessioned at one time or another to a private company, either on a lease basis (*affermage*) or under a strict concession. In all nine cases the concession was terminated early, underscoring the complexity of concessioning a national electrical utility and the delicate balance necessary to keep them operating profitably and effectively. Governments in five other countries of the subcontinent seriously considered concessioning the national utility but ultimately rejected or abandoned the idea.

3. Partly for reasons of affordability and partly because they lack electrical appliances and other devices, rural consumers initially consume only small amounts of electricity, frequently falling within the subsidized segment of the tariff structure often referred to as the "lifeline" tariff. The lifeline tariff does not begin to meet the capital costs of establishing new connections in rural areas. Thus rural electrification must be viewed as a long-term investment in social welfare. It is not profitable within the time frames normally considered attractive to the private sector. For example, in Tanzania, a customer using 40 kWh of electricity each month will pay an effective tariff of $0.073 per kWh, or a total of $2.92 per month—roughly $26 for the year. But because the 480 kWh that the customer consumes actually costs about $0.25/kWh, or $120, the utility incurs a loss of $94 per year for the power supply alone. The capital costs of establishing new connections in rural areas typically exceed $1,000 per new connection. See Kojima and others (2016) and World Bank (2016).

4. For an assessment of meeting financing gaps in public-private partnerships, see Partnerships IQ (2016).

5. The case studies may be downloaded seven case studies can be found at:

Cameroon: http://documents.worldbank.org/curated/en/361311498151364762/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Cameroon.

Madagascar: http://documents.worldbank.org/curated/en/781221498152348689/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Madagascar.

Mali: http://documents.worldbank.org/curated/en/839491498159507682/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Mali.

Senegal: http://documents.worldbank.org/curated/en/710071498161444599/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Senegal.

South African Solar Home Systems: http://documents.worldbank.org/curated/en/708211498162775424/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-The-South-African-Solar-Home-System-SHS-Concessions.

Uganda: http://documents.worldbank.org/curated/en/354661498163378835/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Uganda.

Burkina Faso: http://documents.worldbank.org/curated/en/357991498163872158/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-short-case-study-Burkina-Faso.

6. Guinea Decentralized Rural Electrification Project.

7. Only in the case studies is documentation of private investments presented.

8. Case study on Mali, available from http://documents.worldbank.org/curated/en/839491498159507682/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Mali.

9. It is possible that a single entity operating a number of mini-grids might enjoy economies that would reduce some costs.

10. Uganda established all of its concessions under the framework of the Electricity Act. In 2015, it finally adopted the Public-Private Partnership Act.

11. The performance of these service providers is currently under review by the government of Uganda. Ferdsult recently terminated its concession contract, with the government subsequently requesting the owner of the distribution assets, the Uganda Electricity Distribution Company Limited (UEDCL), to take over the operation of the distribution grid that was Ferdsult's service territory.

12. A detailed discussion of this can be found in chapter 10 of Tenenbaum and others (2014).

13. In fact, South Africa's constitution assigns to Eskom monopolistic rights to supply electricity to the country, so there was no legally binding way to make Eskom respect the agreements with other entities.

14. Isofoton, a manufacturer of solar photovoltaic panels, filed for bankruptcy in 2015.

15. These agreements were still under discussion as of March 2017.

16. Case study of ENEO in Cameroon, available from http://documents.worldbank.org/curated/en/361311498151364762/Evaluation-of-rural-electrification-concessions-in-sub-Saharan-Africa-detailed-case-study-Cameroon.

17. http://www.cie.ci/notregroupe/index.php

18. http://www.veolia.com/africa/our-services/achievements/municipalities/veolia-optimized-resource-management/societe-d-energie-et-d-eau-du-gabon-seeg-gabon

19. http://www.cie.ci/notregroupe/index.php

20. http://eneocameroon.cm/index.php/en/eneo-annual-report-2014/eneo-annual-report-2014-highlights-finances

21. Personal communication from Miguel Revolo, summarized in the unpublished report "Evaluation of Rural Electrification Concessions in sub-Saharan Africa: Short Case Study: Peru" (Revolo 2015.)

22. As the mini- and micro-grid industry in OECD countries grows, some of the scale economies encountered in equipment production will doubtless transfer to developing countries, perhaps through a franchise model. However, by definition, mini-grids installations cannot demonstrate grid-like economies of scale.

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