13 Electrifying Africa

Turning a continental challenge into a people's opportunity

Terri Hathaway

In 2004, 14-year-old William Kamkwamba electrified his family's home in rural Malawi. William's story – of how he worked tirelessly, using pictures of a windmill he found in a small, rural library – was chronicled by local media and has since travelled the world via cyberspace. His story has inspired a book and forthcoming documentary and influential leaders such as Al Gore have used William's story to personify the possibilities in Africa (BBC News 2009, Kamkwamba and Mealer, 2009).

William's remarkable story demonstrates the vast potential for indigenous knowledge and appropriate technology innovations to bring electricity to Africa's rural areas. Like William, two-thirds of Africans live in the continent's rural areas, where only 19% of people have access to electricity. With the right policies and investments in place, William's innovation could be scaled up to achieve much higher rates of rural electrification and at a fraction of the usual connection costs. It could spark rural economic development, local energy security, and reduce vulnerability to climate change.

Yet most electricity sector planning and investments in Africa overlook the rural majority and instead focus on big cities – home to roughly one-third of Africans – including their commercial enterprises and industries that rely on power grids to deliver electricity for work, home life, and leisure. This more visible part of Africa's energy sector relies on centralised power grids that need more power than can be provided by small-scale wind turbines. At their best, power grids offer the most economical, reliable, and widespread access to electricity. Africa's best example in this regard is – arguably – Mauritius. This island nation of 1.3 million people invested in a public rural grid electrification programme in the 1980s, and was the first – and for many years, the only – African country with near-universal access to electricity. Mauritius remains one of only a handful of the continent's countries with an access rate greater than 50%.

However, at their worst, power grids can be costly and ineffective instruments for achieving development. Billions of dollars have been spent on energy systems in Africa that, by and large, have fallen victim to mismanagement, corruption, and unequal distribution of benefits. Poor-quality service and high costs to consumers are too often the result. A recent study (Foster

and Briceño-Garmendia 2010) found that Africa's power costs an average of US$0.18 per kilowatt-hour (kWh) to produce, about twice that found in other developing countries, and expensive backup generators used during frequent power outages can cost up to $0.40 per kWh. Decades of investments notwithstanding, the electrification of Africa – public or private – is failing.

Despite the success of Mauritius and the risks encountered in many other African energy sectors, the World Bank – Africa's most influential energy lender – suggests that the way forward for Africa's energy sector is developing regional power systems based on large power supplies and long transmission lines. The World Bank's 2010 report *African Infrastructure: A Time for Transformation* suggests that Africa needs to spend $41 billion a year on energy infrastructure and regional power trading schemes (Foster and Briceño-Garmendia 2010). Yet, to date, regional planning has been marked by opaque processes that promote large infrastructure projects prone to corruption.

This chapter provides an overview of electricity provision in Africa with a focus on "alternatives to privatisation". Although effective "alternatives" are still few and far between on the continent – due largely to the corruption and unaccountability of state actors as well as policy reforms to enable privatisation and disable public provision – there are innovative examples of public sector electricity provision, sometimes in collaboration with civic organisations. In some cases, such as South Africa, these public sector reforms are contentious, with ongoing opposition to what many see as a commercialisation of the public sector, but this opposition is itself a sign of the desire for change, with inventive proposals emerging from resistance groups for more democratic, equitable, and sustainable systems of electricity provision. The scope of change required is daunting, however, as is the size of the electricity deficit on the continent, as outlined in the following sections.

ELECTRICITY IN AFRICA: AN OVERVIEW

The story of electricity in Africa is a story of access, or rather a *lack* of access. More than half a billion people in Africa do not have access to electricity. Proportionally, electrification in Africa lags behind every other region in the world: only 38% of all Africans – and only 26% of sub-Saharan Africans – have access to electricity, compared to 52% in South Asia, 78% in the Middle East, 89% in China and Southeast Asia, and 90% in Latin America (OECD and IEA 2006).

As shown in Table 13.1, only seven African countries have attained access to electricity for over 90% of their populations; five of these are in northern Africa, and two are small island states. Only three more countries – Cape Verde, Ghana, and South Africa – register rates above 50%. An additional nine countries in sub-Saharan Africa have access rates above one-third, while the majority of countries register electrification levels well

Table 13.1 African countries with national rates of access to electricity above one-third of the population (of 54 countries in total)

Country	*Overall access rate*	*Population*	*GDP per capita*	*Rural access rate*
Libya	100.0%	6.3 million	$14 802	99.0%
Tunisia	99.5%	10.3 million	$3 903	98.5%
Mauritius	99.4%	1.3 million	$7 345	99.0%
Algeria	99.3%	34.4 million	$4 845	98.0%
Egypt	99.0%	81.5 million	$1 991	99.0%
Morocco	97.0%	31.6 million	$2 812	96.0%
Seychelles	96.0%	0.1 million	$9 580	NA
South Africa	75.0%	48.7 million	$5 678	55.0%
Cape Verde	70.4%	0.5 million	$3 193	44.9%
Ghana	54.0%	23.4 million	$713	23.0%
Djibouti	49.0%	0.8 million	$1 030	10.2%
Sao Tome and Principe	48.5%	0.2 million	$1 090	33.7%
Côte d'Ivoire	47.0%	20.6 million	$1 137	18.0%
Nigeria	47.0%	151.2 million	$1 370	26.0%
Botswana	45.4%	1.9 million	$6 982	12.0%
Senegal	42.0%	12.2 million	$1 087	18.0%
Comoros	40.1%	0.6 million	$824	NA
Gabon	37.0%	10.0 million	$10 037	18.0%
Namibia	34.0%	2.1 million	$4 149	13.0%

Source: Legros et al. (2009); World Bank (2008)

below 30%. By looking at population and gross domestic product (GDP) per capita data alongside access rates, it is clear that each African country is experiencing a unique development path and that some anticipated patterns are not present. For example, Morocco has a GDP per capita lower than South Africa, Botswana, Gabon, or Namibia but has attained near-universal electricity access, while the other four nations lag behind. Tunisia has roughly the same population size as Gabon, and just one-third its GDP per capita, but more than twice the electricity access rate.

Africa's access crisis is most acute in its rural areas, where two-thirds of the continent's population lives (see Table 13.2). Only 19% of Africa's rural population has access to electricity, compared to 68% of the urban population. Excluding North Africa, only 8% of rural sub-Saharan Africans have access to electricity. More than 444 million rural Africans are waiting for access to electricity, roughly four times more than the number of urban Africans without access.

Table 13.2 Status of rural electrification in Africa

Region	*Rural population (and as % of total)*	*Rural electricity access*	*Rural population without electricity*
Africa	548 million (61.2%)	18.9%	444.6 million
North	71 million (46.4%)	91.8%	5.8 million
Sub-Saharan	477 million (64.3%)	8.0%	438.8 million

Source: OECD and IEA (2006, 567).

Africa is the only region in the world where the number of people without access to electricity is expected to increase over the next two decades (see Figure 13.1). The population growth rate continues to outpace connection rates in most countries; twice as many households are formed each year as those that receive new power connections. While the *proportion* of Africans *with access* is expected to increase in the next two decades, the *absolute number* of Africans *without access* will grow to 584 million by 2030 (OECD and IEA 2004).

Africa's centralised grid systems have been the traditional focus for energy development and are the electric lifeline for much of the continent's industrial sector and non-poor urban population. Many of these systems are today in serious crisis: starved of investment, facing growing demands, and experiencing poor management of existing infrastructure and finances. Massive investment is needed for grid systems of many African countries after years of poor maintenance and insufficient expansion. Experts estimate

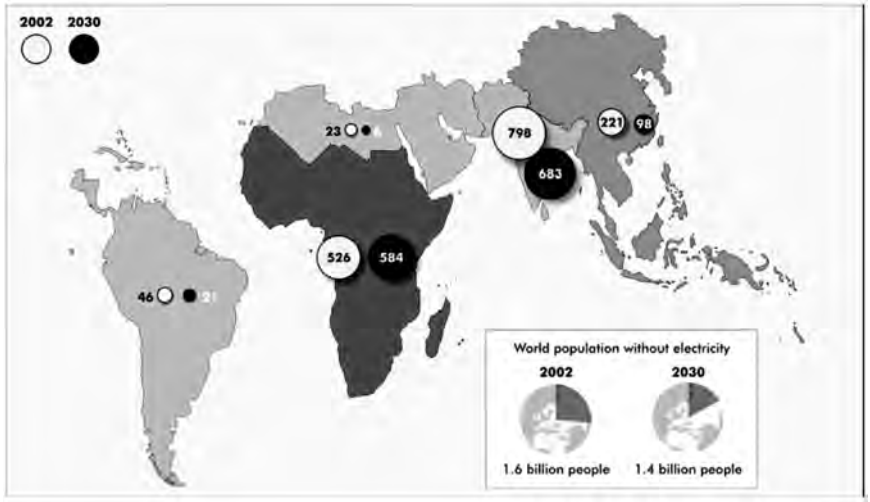

Figure 13.1 World population without electricity, in millions.

Source: Nilsson, H. (2007).

that Africa needs to quadruple its installed capacity – an additional 270 gigawatts (GW) – and locate a staggering amount of investment by 2030, between $484 billion (OECD and IEA 2006) and $563 billion (Bloomberg 2009). According to the World Bank, this translates to $41 billion of energy sector investments each year (Foster and Briceño-Garmendia 2010).

As planned, however, new investments in electricity infrastructure may not increase electricity access rates. Whereas energy experts suggest that at least half of electricity industry investments should be earmarked for transmission and distribution networks (OECD and IEA 2006), the greatest proportion of energy investments needed in Africa is by far in distribution. The *World Energy Outlook 2004* (OECD and IEA 2004) demonstrates that the investment needed in this subsector – $271 billion – is nearly equal to the *combined* investment needed in generation and transmission – $292 billion. Yet major investments in energy infrastructure are currently targeted for high-voltage transmission lines to interconnect national grid systems to share supplies between existing consumers, and to rationalise extra-large supply plants, often large hydropower suppliers such as the massive Inga dams planned for the Democratic Republic of Congo (DRC). While major donors like the World Bank are focused on new generation and regional transmission, prioritising distribution needs is often left to national governments, with very limited external support.

Governments often target new energy supplies that can help lure energy-intensive industries (e.g. aluminium smelters) or industries that can boost GDP (e.g. oil, mining, and timber). Governments may find it more profitable to connect large power consumers than to invest adequately in distribution systems that could expand the grid. They may also neglect to develop smaller, decentralised power sources that could help expand the reach of the grid or better serve communities situated far from it.

African governments play two important roles in the energy sector. First, they create the policy and regulatory framework through which electricity provision is governed. At best, such frameworks can proactively create an *enabling* environment for effective service provision that supports the economic and social development needs of the people. At the very least, the framework should not create a *disabling* environment, in which the government creates barriers that unnecessarily block the development of people. Unfortunately, the history of African governance is one of often failed and fragile states, and, too often, of disabling environments for effective energy development.

The second role that African governments play is as service provider. The majority of today's electricity provision is supplied by government-owned utilities. African power utilities have traditionally been set up as unregulated or poorly regulated monopolies, an institutional arrangement that has contributed to the sector's poor status today. Corruption and poor management, enabled by non-transparency and poorly structured institutions, have reduced the quality and expansion of services.

In 1992, the World Bank introduced a new power sector policy that stressed the commercialisation of power utilities and inherently de-emphasised access to electricity by disadvantaged groups (Covarrubias 1996). In 1997, the bank went a step further, indicating that it would not lend for electricity projects without a clear government commitment to sectoral reform. While few would argue against the need for reform to improve public provision of services, the World Bank's aims were to reduce state intervention in the energy sector to two narrow actions: unbundling and privatisation. Bank-recommended reforms mainly address improvements in the financial and technical performance of power utilities and to date have focused primarily on enabling private sector engagement rather than expansion of public service for the poor. Between 1990 and 2001, however, investment in power sector projects involving private participation totalled a mere $3.1 billion, spread across 22 countries (World Bank 2003). Across most of Africa, private sector involvement did not arrive as expected, leaving Africa's energy sector starved for capital (Bayliss 2007).

While continuing to promote privatisation, the World Bank has been focusing much of its power sector lending to Africa on developing interconnected regional power grids. Significant attention and funding is being put towards the institutional and infrastructure development of regional power trading systems. However, reforms that can improve accountability and promote the expansion of electrification – particularly to rural communities and the urban poor – should be seen as equally important.

The reforms adopted so far have had virtually no impact on increasing access to electricity. Power sector reforms have failed to address exploits by private companies under poor government oversight, corrupt business practices between private companies and government, and improved civil society participation. In other words, there has been little effort to improve public sector electricity providers.

Other lenders play a role as well. The African Development Bank is increasingly important in financing infrastructure projects, and Chinese investment in African infrastructure – much of it in the energy sector – has exploded in recent years. A Frost & Sullivan (2009) report valued Chinese and other Asian commitments in the sub-Saharan Africa electricity sector at $4.44 billion and projects they could grow by an additional $2 billion by 2014. European bilateral donor agencies in countries such as France, Germany, and Sweden have given funding priorities to the African energy sector. Other emerging economies – including India and Brazil – are beginning to invest in the sector. The expansion of rural electrification agencies and initiatives in recent years has seen a variety of multilateral and bilateral support, although activities are often a drop in the energy development bucket. In many African countries, religious organisations may play a more significant role than government in developing pockets of rural electrification. This could lead religious groups to play an increasing role in prioritising access to energy services in Africa's rural regions.

RESEARCHING PUBLIC SECTOR PROVISION

In an attempt to map out the scope and character of non-commercialised service provision in the electricity sector in Africa, several research methods were employed. I began by collecting data on the status of electricity provision and power sector reforms in all countries of the continent where basic data on state-owned utilities were available. National public utilities were researched online due to time and logistical constraints. Additional information was supplemented with secondary literature, where it existed, supplemented with follow-up on specific cases by telephone and e-mail. Academic and non-academic literature searches were conducted and a variety of experts and practitioners were identified and interviewed by e-mail, phone, or in person to provide further information and observations.

Due to the dearth of critical literature on the power sector in Africa, the scope of research on advancing "public" utilities was primarily defined by case studies, as well as the opinions of experts and practitioners. It is possible that data have been produced by the World Bank but are not publicly available. Additionally, many of the African government electricity departments approached for data were unresponsive to e-mail and phone queries. Examples from francophone and lusophone Africa may be underrepresented due to language barriers in the collection of data. Moreover, much of the data collected for this study do not critically assess the implementation of identified targets, policies, and programmes. This would be important for future work.

Although the state of neglect in Africa's power sector is well known, it may be more difficult to see progress and limitations in more recent years, and over shorter spans of time. Like most statistics in Africa, data on access to electricity may be less reliable than in other world regions. Official data may be influenced by a number of factors, including political interests. Electricity statistics may be based on data collected many years previous, and comparative analyses often use data collected at different times and using different methods.

Despite these limitations, this chapter presents the first attempt to systematically and comprehensively review "alternatives to privatisation" in the electricity sector in Africa and advances our understanding of the scope and character of these developments.

NON-COMMERCIALISED ELECTRICITY PROVISION IN AFRICA

Despite the significant push from the World Bank to enable private sector financing and participation in the African electricity sector, the majority of provision remains in the public and non-profit arenas. Roughly 90% of infrastructural needs will continue to be funded by or through the state into the foreseeable future, making the state's role one of the most important

(Bayliss 2007). However, the quantity and quality of electricity provision – particularly in sub-Saharan African countries – remains in a fragile state.

Because the African electricity sector is characterised by low rates of access, the research is focused not just on service provision but also on the state's role in providing an enabling environment for successful service provision. The legal and policy framework provided by the state for its energy sector sets the tone under which service providers must conduct their activities. The current and historical failings of state-owned utilities can often be directly linked to the policy environment in which they operate. The policy environment has also been responsible for disabling other opportunities for the state to meet its goals of electricity provision. The state also sets the tone for the kind of development that the power sector will support.

For this research, non-commercialised service providers are categorised into four types: state-owned utilities; state-based rural electrification programmes; community initiatives; and single-institution providers.

State-owned utilities

This category covers by far the majority of public electricity supply in Africa and has the overall largest number of customers. However, most state-owned utilities have been corporatised and commercialised following sector reforms undertaken in recent years. Many have undergone some type of commercialised change and others are in the process of undergoing, or are predicted to undergo, similar reforms. Few have been successful in attaining high rates of access to electricity or rapid growth in access rates.

About half of all African countries have retained a vertically integrated state-owned power utility monopoly (see Table 13.3). A few countries, such as Mozambique and Namibia, operate a state-owned system with more than one institutional provider but do not currently have private sector ownership. Twelve countries – including Egypt, Ghana, and Zambia – have both state and non-state service providers. At least 10 countries are engaged in long-term contracts and/or have sold off some or all of their assets. Several countries, including Ghana, Egypt, Namibia, and South Africa, have set up regional power distributors. Many countries, including Egypt, Guinea, Mali, and Rwanda, have undergone privatisation, only to be reclaimed by state ownership. Several countries underwent management contracts that ended and reverted to state management. Some utilities, such as the Zimbabwe Electricity Supply Authority, were restructured for sale but have failed to attract investors.

African power utilities have traditionally been set up as unregulated or poorly regulated monopolies, an institutional arrangement that has contributed to the current poor status of the sector. Most have failed to address electrification for the poor, with only nine African countries registering access rates above 70%. These systems largely obtained their high access rates prior to power sector reforms in which state-owned utilities were commercialised. Some of these utilities are described briefly below.

Table 13.3 African Countries by state and non-state provision of electricity services

Countries with fully state-owned systems (monopoly or multiple providers)	Benin, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo,* Equatorial Guinea, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau,** Lesotho, Liberia, Libya, Madagascar,** Malawi, Mauritania,** Mozambique, Namibia, Niger,* Rwanda,** Seychelles, Sudan, Swaziland*, Tunisia, Zambia, Zimbabwe*
Countries with state and non-state providers	Algeria, Angola, Egypt,** Ghana, Kenya, Mauritius, Morocco, Nigeria,* Senegal, South Africa, Tanzania, Zambia
Full or partial control of electricity sector assets by non-state actors	Cameroon, Côte d'Ivoire, Gabon, Kenya, Mali**, Morocco, Republic of Congo, Reunion, Sierra Leone, Uganda, Zimbabwe

* prepared for privatisation; ** state control regained after non-state engagement.
Source: Lists based on author's research of energy sector by country.

North Africa has managed to obtain near-universal access levels in recent years. In Libya, the General Electricity Company of Libya (GECOL) is responsible for generation, transportation, and distribution of electric power in the whole country. Libya is the only African country with 100% electricity access rate. The state's objective has been to electrify all Libyan towns and cities with the lowest possible operating cost and with an acceptable level of continuity and quality of electricity supply. GECOL has an installed capacity of 6 284 MW and 1.2 million customers.

Before its utility was commercialised in 2002, Algeria already had 5 930 MW of installed capacity, exporting surplus power to Morocco and Tunisia. State-owned Sonelgaz – which controls electricity generation, transmission, and distribution – was converted into a private company in 2002, although the Algerian government continues to hold all of the company's shares. The 2002 law also created the Electricity and Gas Regulatory Commission to oversee the newly opened industry. Algeria aims to eventually split Sonelgaz into separate generation, transmission, and distribution companies, although those plans have faced domestic opposition from organised labour. Since the opening of the sector in 2002, there has been considerable private investment in new electricity-generating capacity.

In Tunisia, the *Société Tunisienne de l'Électricité et du Gaz* (STEG) maintains a monopoly on electricity supply, transmission, and distribution. As of 2009, STEG operated a total power supply of 3 465 MW and had over 3 million customers. According to Practical Action Consulting's (2007)

technical brief on grid connection, Tunisia's decision to adopt a lower-cost distribution technology is the single most important reason for the country's success in rural electrification. (It remains to be seen what effect the political changes in Tunisia, and elsewhere in North Africa, in 2011 will have on these services but they may serve to democratise state services further.)

Approximately 40 African countries operate small power grids with a capacity of less than 1 000 MW each. Arguably the most successful of these utilities in terms of access rate is the Central Electricity Board (CEB) in Mauritius, which was established in 1952 and completed its rural electrification programme in 1981. As of 2008, CEB operated a system with an installed capacity of 733 MW, although peak demand is only 378 MW (CEB 2008). CEB restructured in 2004 to become a vertically integrated utility. An independent regulator was created for the electricity industry and an external contractor was brought in to assist in CEB's management. CEB generates 40% of the country's total power requirements and purchases the remaining 60% from independent power producers that generate *bagasse*, an energy supply using agricultural waste from the sugar industry. CEB is the sole organisation responsible for the transmission and distribution of electricity to the population. Mauritius has one of the highest GDP per capita in Africa.

In South Africa, Eskom is the state-owned utility that has long dominated the country's and the region's energy sector. Eskom is one of the world's largest power companies and produces nearly half of Africa's total electricity. When the African National Congress (ANC) came to power in 1994, an electrification target of 2.5 million new connections by 2000 (450 000 per year) was set, far larger than the maximum 25 000 connections per year provided in the waning days of apartheid (Greenberg 2009). Funding was provided by Eskom's internal funds, but a combination of corporatisation and increasing costs per connection – as lower-cost connections were completed first – led to a sharp decline in connections after 2003.

For 58 years, Eskom was mandated to "render, by the provision of power without profit, a worthy and ever-increasing contribution onto the development of South Africa and the welfare of her peoples" (Gentle 2009). In 1948, South Africa's power sector already possessed 2 378 MW, more than double the size of most African power systems today. Prior to the end of apartheid, Eskom had achieved near-universal electricity access for its white population, while funding of basic services for the country's majority non-white population had systematically been neglected. While the power sector of the racist apartheid era was grossly inequitable, it does speak to the capacity of a state-owned system in a non-commercialised setting to achieve the goals it has set out to accomplish.

South Africa's post-apartheid electrification programme has achieved some success but is falling short of anticipated goals. At the same time, the country's Free Basic Electricity Programme has been hindered by

implementation barriers, resulting in a situation where very few of those who most need it are benefiting from the programme. When promises to provide free basic services were not kept, communities and activists organised political struggles using civil disobedience (Ruiters 2009).

State-based rural electrification programmes

State-based rural electrification programmes have been much less successful than their urban counterparts in Africa. Where they do exist, rural agencies are generally tasked with increasing connection rates but may not be considered a long-term service provider. Many are separate institutions, but some countries have created a department within the main power utility. The programmes are often financed through a levy on electricity services provided by state utilities with supplemental funding from development banks and other donors. The agency may connect new communities to the national power grid serviced by the utility, develop a minigrid for rural communities, or provide individual household systems. There is very limited research available that evaluates the progress of state-based rural electrification programmes on the continent.

Rural electrification in Africa has been impeded by the high financial costs of connecting Africa's sparsely populated rural areas to the centralised grid. In Kenya, for example, the average cost of a new connection for a rural home is seven times the national per capita income (REN21 2008). The high cost may also indicate a lack of political will to drive alternative initiatives, despite the fact that African households and small businesses spend upwards of $17 billion annually – 30% of disposable income – on kerosene and other fuel-based lighting (Lighting Africa 2008).

Most national rural electrification agencies began in Africa in the 1990s as part of power sector reforms (Mostert 2008). These agencies were created to address the dismal rates of rural electricity services and spur new sources of funding to address the needs. Such agencies were often poorly integrated into reforms, which prioritised urban services, and were typically introduced at a late stage in the preparatory process. Despite the hope that reforms would lead to additional funds for rural electrification, rural connections remain dismal. Private investors in the electricity industry have tended to target lucrative urban and industrial consumers.

A 2004 study by the Global Network on Energy for Sustainable Development (GNESD 2004) identified several factors that contributed to the success of rural electrification programmes in Mauritius, Morocco, and Tunisia. Most importantly, the funds raised by levies were ring-fenced, meaning they used transparent planning and project selection processes and closely monitored the use of dedicated funds for rural areas. The governments in all three countries demonstrated great political will to accomplish rural electrification through financial contributions and by planning

connections across all socio-economic groups without prioritising less expensive communities. Rural communities participated in the decision-making bodies, making contributions towards the electrification of villages and in the selection of the schemes to be electrified.

Other rural electrification programmes have been less successful. In Kenya and Zambia, the rural electrification levies were not ring-fenced, allowing the funds to easily be mixed with other utility or national revenues, without being used to expand access (Karakezi and Kimani 2002). In Kenya, despite a rural electrification levy in place for 30 years, only 1% of the rural population has access to electricity (see Table 13.4).

Some government electrification programmes provide financial incentives for unelectrified communities that meet certain criteria to fast-track new electricity services. Often the communities are encouraged to participate either through financing the connection or providing community labour towards the construction of physical infrastructure. Some African countries have supported the use of electric cooperatives to connect rural communities. In Burkina Faso and Ethiopia – where cooperative ownership solutions enjoy political support – community cooperatives are encouraged to help organise new community connections as part of their respective rural electrification programmes.

In Morocco, the *Office National de l'Électricité* (ONE) was created in 1963 to meet the electricity requirements of the country. It remains a state-run company with 9 000 staff and approximately 3.5 million customers. In 1997, when 45% of Moroccans lived in rural areas, but only 18% had access to electricity, the Moroccan government implemented the Global Rural Electrification Programme with the goal of 100% rural electrification within 10 years. Between 1997 and 2008, ONE connected 4 000 communities per year, and Morocco's rural electrification programme has succeeded in increasing Morocco's access rate to 99%. Most new connections were provided by grid extension, while 7% were provided by decentralised electrification – namely, solar Photovoltaic PV kits.

Table 13.4 Rural electrification programmes in four countries

	Morocco	*Tunisia*	*Mauritius*	*Kenya*
Duration of programme	27 years	32 years	37 years	31 years
Estimated total investment on capital cost (US$ millions)	$4 050	$585	$22	$103
Estimated number of connections	5 375 000	609 000	737 000	93 080
Rural electrification rate	72%	96%	100%	1%
Average cost per connection	$753.49	$960.59	$29.85	$1 106.57

Source: GNESD (2004, 9).

In 1989, the government of Ghana launched the National Electrification Scheme (NES) and the complementary Self-Help Electrification Programme (SHEP) as a rolling electrification programme. The goal was to connect all communities with more than 500 people to the national grid by 2020. When the NES was launched in 1989, Ghana had 3 743 target communities. By 2004, the NES and SHEP had managed to electrify over 3 000 communities (Mostert 2008).

Communities located within 20 kilometres from the grid but not scheduled for immediate connection can apply for SHEP funds to fast-track electrification, but they must first meet additional requirements. They must procure a required number of poles for the distribution network and have at least 30% of the households wired for service as soon as electricity supply is connected. An interested community is required to set up a village electrification committee that has several responsibilities, including mobilising funds to purchase low-voltage poles, assisting in acquisition and clearing of right-of-ways, and providing public information and awareness on wiring homes.

In Burkina Faso, community cooperatives called *coopel* are used to develop rural electrification schemes. For isolated minigrids, the *coopel* owns all assets. For grid-connected projects, the *coopel* owns the distribution system and transformer. It has two committees: the grid committee for decisions on grid extensions and connections, and the management and control committee for management, tariff setting, and accounting issues. A management consultant from the National Federation of Cooperatives provides assistance during the first two years of operation. However, *coopels* are required to tender a construction and five-year operation and management contract for the implementation of their project. The private manager-operator is responsible for system operation, system safety, billing, securing payment of bills, connecting new customers, and extending the distribution grid. The operator receives a monthly fee proportional to the number of customers (Mostert 2008).

In Ethiopia, more than 200 electricity cooperatives have been registered. The rural electrification fund uses regional energy bureaus, regional cooperative offices, and debt financing from the Ethiopia Development Bank to support the development of electricity cooperatives. Although Ethiopia's national utility subsidises tariffs in its diesel-based community grids, systems developed under the rural electrification fund are not subsidised, causing a greater financial burden to members of electricity cooperatives. Fuel costs have continued to rise faster than tariffs, and many cooperative systems have reduced their operating hours to compensate. New cooperatives under design have been downsised and barred energy-intensive uses (Mostert 2008).

References to a small number of existing and planned electric consumer cooperatives in rural areas were also found in Kenya, Sudan, and Tanzania and are planned in Uganda.

Community initiatives

Community initiatives provide electricity for households and institutions within one or more nearby communities. Electricity is generally supplied by one local energy source or a combination of sources, also known as a hybrid system. Hybrid systems may rely on a combination of microhydro, wind, solar, and/or diesel.

Electric consumer cooperatives, where consumers are members and collectively own the system, were found in four countries. In all, 48 examples of existing community systems were found across 16 countries, although more research would be needed to determine the current status and sustainability of each system. The Global Environment Fund (GEF) has helped finance 18 of these systems.[1] The systems are supplied by a variety of renewable and non-renewable sources, as seen in Table 13.5.

Despite the vastness of the African continent, there are relatively few cases of community electrification systems that have been initiated by and remain under community management. Historically, most community electricity systems were supplied by diesel generators. As fuel prices have risen and other technologies have received more attention, there are increasing examples of community electricity powered by microhydro, wind, and solar. Limited financing options for infrastructure is often a constraint to scaling up community systems.

In Cameroon, a local NGO, *Action pour un Développement Équitable, Intégré et Durable* (ADEID), has assisted four communities in constructing village electricity systems using microhydro projects; two more are under construction but not yet operational (see Table 13.6; Nkeng 2009). Local engineering and materials are used to manufacture the power system, and

Table 13.5 Examples of decentralised grids in Africa

Type of power supply	*Total examples found*
Solar	6
Microhydro	17
Wind	6
Diesel	5
Biogas	2
Methane	1
Jatropha	2
Hybrid	5
Unknown	4

Source: Author's research.

Table 13.6 Microhydro electrification projects by ADEID, Cameroon

Community	*System sise*	*Customers*	*Availability*
Bellah Nganga Fontem	7.5 kW 3-km transmission	1 health centre 60 households	24 hrs/day, all year
Nefolem-Baleng	5 kW 2-km transmission	1 health post 1 school 25 households	12 hrs/day, 10 months
Tongou-Baleng	6 kW 2-km transmission	1 school 50 households	12 hrs/day, 10 months
Quibeku Fontem	10 kW 3-km transmission	1 school 1 church 70 households	24 hrs/day, all year

Source: Nkeng (2009).

ADEID has assisted each community in developing a local management system. Systems have been financed partially by grants and partially by loans from international private funders. Each village has set up a management committee, but results have been mixed.

In The Gambia, the non-governmental organisation German Association for Rural Electrification (*Dorfelektrik in Gambian E.v*) initiated a minigrid to electrify the village of Batokunku. In 1999, a six-kilometre transmission line was connected to an overhead grid line that had previously bypassed the village. About 50 households and a community water pumping system began to receive electricity. In 2000, a 150-KVA wind converter with a total height of 41 meters was received from Denmark, where it had previously been in operation. The community founded Batokunku Wind Power, which is overseen by an elected committee. In May 2008, a power purchase agreement between Batokunku Wind Power and the National Water and Electricity Company (NAWEC) was signed that defines the terms of agreement between the two parties as a non-profit pilot project for green energy in The Gambia. The village applied for a licence from The Gambia Public Utilities Regulatory Authority (PURA). After deducting the operating costs, surplus revenues are either reinvested into the network to connect new citizens or into other village social projects. Batokunku Wind Power could eventually serve a network of about 1 000 villagers.

In Kenya, at least four community-owned microhydro systems are operational, and it is believed that up to three megawatts of microhydro could be generated across the country (Legros et al., 2009). Each system in operation is owned by an electricity users association that must register with the government's Department of Social Services in order to obtain a permit for abstracting water for electricity generation (Kirubi 2009). At each site, monthly membership fees of about US$3, equivalent to the local

daily wage, are set and collected by the relevant association. Each user association implemented the advice to set tariffs and monitoring systems by maximum demand rather than by power consumption. A mechanism for allocating power was developed that uses "light packages" to determine household demand. Each light package is equivalent to 10 watts, and a household can choose how many light packages it will pay for on a monthly basis. Exceeding the limit is monitored by a load limiter that instantly disconnects the household if the amount is exceeded. To regain supply, the user has to unplug certain loads.

In Zambia, the North West Zambia Development Trust owns and operates Zengamina Power, a 750-kW hydropower station and 35-kilometre distribution network system. The system was built to help replace costly diesel generation at Kalene Mission Hospital and to promote rural development in the surrounding communities by providing electricity to farms, businesses, and rural households. Planning began in 2003, though previous studies were done as early as 1964. Fund-raising and construction began in 2004. The system became operational in 2007 and currently supplies electricity to two towns, one large farm, one school, two mobile phone towers, and 130 private customers. Power demand is only about 20% of supply, but operators expect that demand could rise to 40% as the existing customer base increases their reliance on electricity. Zengamina's operators anticipate that it could support up to 1 000 customers in the future, reaching full capacity within 10 years. The $2.9 million project cost was funded through donations and a $25 000 subsidy from the Zambian Rural Electrification Authority. Zengamina Power employs 10 people full-time and another 10 part-time when electricity poles are being erected (Rea 2009).

While outside the scope of this chapter's research, there is one very innovative project tackling a controversial subject: *jatropha*, an alien plant species whose seeds produce oil for biofuel. In Mali, the village of Garolo has married together *jatropha* cultivation and a local electricity service using biodiesel, while trying to avoid harming local food security (Practical Action Consulting 2009). The 300-kW electric minigrid has 247 customers and engages 326 farmers who grow *jatropha* on lands that do not compete with local food crops. The power grid is owned and operated by a local private company that is an offshoot of a local NGO, Mali Folkcenter. The system was implemented with support from the national rural electrification agency and technical assistance from a German NGO. Project developers believe it has the potential to benefit more than 10 000 inhabitants through improved social services and income-generation activities (Morris and Kirubi 2009).

Clarifying and reducing the regulatory obligations for small systems can help make the difference between encouraging or discouraging community systems. Some countries have changed the regulatory framework to better enable community initiatives:

- In Mali, no authorisation is required for isolated grid projects involving less than 20 kW of power supply.
- In Burkina Faso, systems with capacities lower than 10 kW need no authorisation; systems between 10 kW and 35 kW need an authorisation; and systems larger than 35 kW require a concession.
- In Tanzania, the 2008 Electricity Act enables community electricity systems to sell excess power back to the grid.
- Kenya's revised Energy Act of 2006 ended the state utility's monopoly for power distribution by permitting private generation and distribution of electricity, enabling community initiatives to operate.

Another innovative community power system is the Multi-Functional Platform (MFP), in which a platform is built around a diesel engine that can power various tools, such as a cereal mill, husker, alternator, battery charger, pump, and welding and carpentry equipment, and generate electricity for lighting and pumping water. MFPs can be found in Benin, Burkina Faso, Ghana, Guinea, Mali, and Senegal; more than 450 MFPs have been installed in Mali alone, where the Malian Agency for Household Energy and Rural Electrification (AMADER) subsidises up to 80% of the cost for each platform. MFPs can be installed and run using local management and local engineering. Often, a women's management committee is created to operate the MFP. New tools can be added to the MFP over time as the team acquires the capacity to finance new equipment. Typically, a grid up to three kilometres long can be attached to the platform, connecting 80% of the households situated within its service area. MFPs have an average lifespan of up to four years. Installation of an MFP usually occurs after conducting a feasibility study. The total cost, including installation, is approximately $7 000, while up to $5 000 in additional support for capacity and management development may be provided.

In Burkina Faso, the government has co-financed 46% of the MFP installations, with another 10% coming from the United Nations Development Programme (UNDP), 9% from beneficiaries, and 35% from other donors. Financing is facilitated through an arrangement between the NGOs implementing the projects, the network of local credit and savings cooperatives, and the Regional Solidarity Bank. The government and UNDP have been responsible for developing the beneficiaries' capacity and monitoring and evaluating the MFP enterprises' performance. The Regional Solidarity Bank lends to the credit and savings cooperatives, which then provide small-scale finance to individuals with enterprises enabled by energy services provided by an MFP, such as welding and grain milling (Morris and Kirubi 2009). MFPs are credited with creating nearly 2 500 jobs in eight regions, in addition to saving about two hours per day of women's labour. The government of Burkina Faso would like to roll out the MFP programme to 13 more regions.

Another unique model for community electrification comes from the Barefoot College based in India. Since 2004, the Barefoot College has

trained 110 rural African women, mostly grandmothers, as solar engineers. As a result, these women have solar-electrified 5 500 remote rural houses in 15 African countries.[2] The training centre works on the premise that the very poor have the right to have, own, and access the most sophisticated technologies to improve their own lives. By design, the Barefoot College accepts only illiterate and semiliterate middle-aged women for their training because these women have a vested interest to stay in their villages. Selected trainees are invited to the centre in India for six months of training. Trainings are conducted by previous trainees; no written materials are used. After returning to their villages, the women are able to fabricate, instal, maintain and repair residential solar lighting systems.

Before a village is solar-electrified under this programme, a Village Energy and Environment Committee (VEEC) is formed. The VEEC is responsible for determining the household tariff structure and for selecting a woman from the village to be trained as a Barefoot Solar Engineer. Once the village is electrified, the VEEC continues to monitor funds and the performance of the Barefoot Solar Engineer. Households paying into the village solar system receive up to four hours of electric light every night.

Single-institution providers

This final category refers to non-commercialised service providers created to generate electricity for a single user, and is broken into two subcategories: institutional (such as a hospital or school) and household. Institutional systems are typically set up to run a single community service without expanding the service for community use, often for health care or educational institutions. Such systems are often run by non-profit organisations.

As decentralised energy systems become more available, better known, and less expensive, individual demand for private household systems is increasing. Demand for these services will likely come primarily from higher-income rural households and will be installed for domestic use or entrepreneurial activities conducted from the home, or both. Such systems can provide a rare opportunity to develop local livelihoods for builders (e.g. microhydro and small wind turbines), distributors (e.g. solar photovoltaic), and maintenance technicians. They can also provide badly needed electricity for regular household use, as in the case of William Kamkwamba outlined at the start of this chapter.

Churches and faith-based groups have contributed significantly to integrating electricity supplies for rural hospitals, schools, and other social service institutions (similar to their involvement in the health care sector in Africa, as discussed in Chapter 11, this volume). These types of installations are generally provided to services managed by the church organisation and do not usually involve community-wide electrification. In Uganda, for example, the Solar Light for the Churches of Africa project was a $6-million, faith-based

initiative established to electrify 5 000 individual churches, schools, health clinics, community centres, and homes over 20 years (US Department of Energy 2002). The initiative was financed by the Church of Uganda and a US-based foundation. Installation and maintenance are provided by Solar Energy for Uganda, Ltd. In the DRC, numerous mission-run clinics and hospitals are operating their own power systems (Boyd 2010).

Likewise, individual household provision of electricity accounts for an increasingly important part of electricity access and consumption in Africa. Households in particular may rely on local entrepreneurs who sell the products and provide maintenance. Often, the local markets that sell these goods have been or are supported by government or non-profit initiatives to develop consumer awareness of the goods.

Solar home systems are one of the most common forms of individual electricity systems in Africa. South Africa's solar PV installation is estimated at 8 MW. In the Eastern Cape province, there is a plan to instal 50 000 solar home systems and a million homes could eventually use these types of systems. About 2 000 systems have been installed in schools and 200 in rural clinics (Ward 2002). In Kenya, 30 000 PV systems are sold annually, making it a global leader, per capita, in sales of residential renewable energy systems (Kammen and Jacobson 2005).

Solar PV has come under criticism due to a high rate of poorly maintained instalments, however. Solar PV installations are generally limited to lighting and other small power demands. The inability to run domestic appliances with higher loads has helped give solar PV a stigma as inferior to grid-based electricity. In South Africa's Eastern Cape, households have declined solar home systems offered by the government because they believe it will reduce their chance to be connected to the public grid. Rural solar PV installations have also been criticised because supplies are static and do not permit growth of consumption.

Diesel generators have long provided individual access to electricity. One of Africa's most notorious examples is Nigeria, where chronic power outages and unreliability of the national power grid has driven the use of individual generators. According to a 2008 report, Nigerians spend US$140 billion annually on fuelling private generators in the country, including almost US$67 billion for residential use and US$13 billion for commercial use (*Vanguard News* 2008).

Car batteries also serve as a relatively accessible, though costly, source of electricity. In Mozambique, there are an estimated 25 000 car batteries sold for the purpose of home electrification. A car battery is carried – often significant distances – to a location where it can be recharged for a fee; power at the charging station is usually provided by a diesel generator or from grid electricity supply. The small amount of power in the battery is then typically used for lighting or to run a television and radio. Electricity from a car battery can cost up to US$5 per kWh (Greenpeace and ITDG 2002).

LESSONS LEARNED

Engaging civil society

Africa's electricity sector has largely failed Africa's poor majority and will continue to face enormous obstacles for decades to come. In the face of relatively low levels of political will, among the most important factors to fast-track public electricity connection in Africa will be participation, advocacy, and monitoring by communities and civil society.

Although seldom mentioned in recent critical literature, civil society engagement in the power sector is working to ensure government accountability, pro-poor planning, and the development of community-level electricity services. In 2003, a worldwide network of NGOs formed the Citizens United for Renewable Energy and Sustainability (CURES) to monitor the energy-related international processes, which had resulted from the 2002 World Summit on Sustainable Development. CURES prepared a declaration as the common position of this group to influence the 2004 international conference on renewables held in Bonn, Germany (CURES 2003). There is currently an active southern Africa CURES network, as well as a West African CURES network. In 2003, the African Rivers Network was formed to bring together communities and NGOs engaged in struggles against large dams, mainly hydropower dams. In 2006, the network published a booklet of case studies related to social and environmental impacts of hydropower dams in Africa (ARN 2006). Another strong civil society group is the South Africa Energy Caucus.

Some countries, such as Tanzania and Cameroon, have seen public protests against negative impacts on service provision due to privatisation. Trade unions in Algeria, Nigeria, and South Africa have also opposed privatisation of energy services. Light Up Nigeria, a grassroots advocacy movement for improved power supply, began in August 2009. The founders drafted a power bill that would incorporate their demands to the Nigerian government for a sustainable power service. By using the web-based social networking tool Facebook, Light Up Nigeria has attracted over 28 000 members.

Perhaps the best known case of civil society engagement in the African power sector is the collective struggles of South African townships to resist paying for electricity and other basic services, both during and after apartheid. As part of the anti-apartheid struggle, many townships engaged in boycotts against the provision of poor and unequal services, including electricity provision. When the ANC came to power in 1994, its Reconstruction and Development Programme promised "free basic services" for all. However, by 2000, the public South African utility Eskom began a serious campaign to disconnect households that were not paying for service and/or owed large amounts to the utility. Up to 20 000 households were being disconnected each month in the Soweto township alone (Naidoo and

Veriava 2009), with hundreds of thousands more being disconnected by public, municipal-level electricity distributors (McDonald and Pape 2002).

The Soweto Electricity Crisis Committee organised collective resistance that used illegal reconnections as a political tool. This organised resistance led to three achievements. In October 2001, Eskom announced a moratorium on cut-offs in Soweto. A month later, Eskom announced it would cancel 50% of residents' arrears, reform the billing process, and give amnesty to those reporting illegal connections. In May 2003, Eskom cancelled all arrears in Soweto and other nearby townships. But these wins were followed by the implementation of prepaid electricity meters, a move many South African groups have criticised for disempowering consumers (Naidoo and Veriava 2009), and cut-offs continue.

Electrification targets

In order to not backslide, African utilities must add new connections faster than new households are created. Without special public policies to address the needs of underserved rural populations, not only will the electricity gap continue to grow but so too will the equity gap between those with and without electricity access. For the majority of African countries, this has remained a major challenge and they are only slowly beginning to set targets for new connections in order to catch up (see Table 13.7). In 2001, Mozambique's utility EdM had 279 000 customers. By 2006, EdM had increased its number of clients to 387 000.

Some attention has also slowly begun to focus on regional initiatives to expand access to electricity and energy in Africa. In 2002, the World Summit on Sustainable Development called upon the international community "to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the Millennium Development Goals (MDGs)...bearing in mind that access to energy facilitates the eradication of poverty" (WSSD 2002, 5). By 2005, a UN strategy

Table 13.7 Selected examples of national electricity access targets

Country	*Current overall access*	*National target*	*Rural target*
DRC	11.0%	67% by 2025	50% by 2025
Ghana	54.0%	100% by 2020	100% by 2020
Mali	17.4%	20% by 2011	8% by 2011
South Africa	75.0%	100% by 2012	100% by 2012
Togo	20.0%	66% by 2016	40% by 2016
Zambia	19.0%	41.8% by 2016	15% by 2016

Source: Legros et al. (2009).

to "energise the MDGs" had been outlined, and the Forum of Energy Ministers for Africa (FEMA) committed to three serious targets for ramping up access to energy but at an underestimated cost: 50% of Africans living in rural areas should have access to modern energy services such as improved cookstoves; 50% of the urban and peri-urban poor should have access to reliable and affordable modern energy services; 50% of schools, clinics, and community centres should have access to modern electricity services for provision of lighting, refrigeration, information, and communication technology (Bbumba 2005). Since 2006, the European Union Energy Initiative has led efforts to develop energy access strategies at the subregional level in sub-Saharan Africa. This effort is currently expressed through the three-year Africa Electrification Initiative (2009–2011).

In 2006, the Economic Community of West African States (ECOWAS) determined that $52 billion must be invested by 2015 to energise the region to meet its Millennium Development Goals (ECOWAS 2006). For that price, the region could bring modern cooking fuels to everyone, increase electricity access in cities to 100%, and in rural areas to 33%, and make electricity and mechanical energy available to two-thirds of rural communities. With a regional population of 300 million people, the required investment is $16 per person per year. While other African regions are tackling the same issues, ECOWAS has made the most progress in calculating required investments. Based on ECOWAS's work, sub-Saharan Africa would require $12 billion a year in energy service investments in order to halve the region's poverty as defined under the Millennium Development Goals, about one-third of the $41 billion annual investment assessed by Foster and Briceño-Garmendia (2010). This aligns with estimates published in the *World Energy Outlook 2006*, that an annual investment of $35 billion a year until 2030 could achieve universal access to electricity (OECD and IEA 2006).

Households within grid-electrified regions may still not have access to electricity, or may limit their usage. Poor households are challenged in two ways. First, connection fees charged by the utility can be too high for a household to pay all at once. Second, housing must often be of a certain standard for connection, barring those living in the poorest housing structures from accessing electricity. As a consequence, only about 10% of the households in electrified, rural communities in Tanzania are actually connected, even a decade after their rural electrification programme began. The investment required for an electric stove and appropriate cooking utensils remains an obstacle to electric cooking, even for electrified households (Kjellstrom 1994).

Effective policies

Improving energy sector policies is a prerequisite for building an effective environment for non-privatised electricity services. In recent years, a body

of literature critical of power sector reforms has emerged, with important implications for improved public sector service provision. Important policies include:

- autonomy and authority in regulatory boards;
- utility performance evaluations and licence renewals based on technical performance and meeting connection targets;
- provision of targeted subsidies for poor households that minimise or eliminate connection fees and fixed charges;
- least-cost electrification options and appropriate technologies;
- improved oversight of state-owned enterprises;
- new approaches to attack system losses, raise collection rates, and improve customer service.

While much of this language has been used to promote private sector investment and participation in electrification in the past, or to push for the commercialisation of public utilities, it can be equally valid to apply these principles, and even modify them, to non-commercialised public electricity entities in Africa, most of which would benefit from better management and transparency. It is important, for example, that "least-cost" electricity options do not mean substandard provision for the poor and that electricity users be seen as participative members of an electrification system rather than just passive "customers". Without addressing some of these policy and institutional factors, barriers to effective public service provision will remain, and services will not be able to flourish.

Community management

Hundreds of defunct demonstration and village power projects across Africa have proven the need for sustainable management beyond the set-up of the power supply. Financial and technical oversight of any shared power system is essential. Two excellent guidebooks could help communities navigate how to set up ongoing management: *Guides for Electric Cooperative Development and Rural Electrification* (NRECA International, n.d.) and *Electricity Services in Remote Rural Communities* (Sanchez 2006). These guides help identify best practice for tariffs, contracts, and system oversight within the rural context of developing countries and with the aim of promoting the broader public good in energy provision.

Financial sustainability

Cost recovery and subsidies are key debates in Africa's electricity provision. Decades of subsidies to the power sector in sub-Saharan Africa have failed to make electricity accessible or affordable, largely because access to service is almost entirely confined to the wealthier segments of society.

Appropriate subsidies can increase access rates, ensure that electricity costs are affordable to poor communities, inhibit inefficient use, and ensure that industrial users are not disproportionately benefiting from the system. Ending power subsidies for higher-income groups could allow resources to be reallocated to subsidise the expansion of power networks to serve lower-income rural and peri-urban communities.

The poor are often caught in the middle, with no access to modern energy services and limited options for financing to purchase such services. Recent research also suggests that it is the infrastructure – not the monthly use charges – that is the most prohibitive for low-income users. Subsidies that target connections and upfront costs will reach poor consumers better than subsidised tariffs. After studying examples in Burkina Faso, Kenya, and Tanzania, Morris and Kirubi (2009) found that access to modern energy services can be increased if small-scale finance options are available, and that the government can play a catalytic role in putting the pieces into place.

High-cost technologies are also an inhibitor. Adoption of low-cost technologies in electrifying rural areas was another important measure used successfully in Tunisia, Morocco, and Mauritius. Standards that could help to ensure cost-effectiveness include "single-wire earth return" and transformer locations that are determined on a line-by-line basis depending on current and future demand growth (GNESD, see www.gnesd.org).

In South Africa, the Free Basic Electricity policy entitles poor households to receive a minimum amount of 50 kWh of electricity per month for free. Lifeline tariffs such as this one have largely been criticised by the World Bank and other institutions engaged in sectoral reforms as undermining the financial sustainability of state utilities, leaving them largely unable to cover expenses or maintain – let alone expand – their system. However, targeted subsidies that are well implemented can allow the state to meet its welfare goals. Increased rates paid by higher-consumption users can accomplish multiple goals; they can provide funds to help cover the costs for more connections, and they can cross-subsidise the costs for the poorest – often lower-consumption – users. Higher rates can also motivate users to become more energy efficient.

For community systems, Kirubi has argued that the design of the tariff system depends on whether the systems' variable and fixed costs are high or low:

> A system with high variable costs (e.g. a diesel system) demands reasonably precise monitoring of energy consumed so that users are billed for each unit of energy used. Such a tariff is commonly referred to as an energy-based tariff. In contrast, when a system has low variable costs and high fixed costs (e.g. microhydro), a capacity-based tariff makes much more sense because the marginal cost of consumption is insignificant. (2009, 57)

Community-based grids in rural areas in particular can benefit from load-limiting devices such as electrical ready boards. These devices can be used to enforce capacity-based tariffs, designed to limit the maximum power consumed.

Revenue collection is a legitimate issue. While emphasis in some countries has been put on residential collection and enforcement measures such as controversial prepaid meters, government institutions are also often delinquent, with far less chance for enforcement. In the DRC, public companies owed the state power company US$500 million. In 2003, Zimbabwe's utility, ZESA, owed US$110 million in arrears to power utilities in neighbouring countries, including: US$27 million to Mozambique; US$11 million to South Africa; and US$5 million to DRC and Zambia (*The Independent* 2003). Despite halving the arrears in 2006, the amount owed to neighbouring countries had again grown to US$100 million (*Chronicle* 2010).

"No regrets" planning

Countless African countries have faced unexpected power shortages in recent years. Some outages have been due to hydropower shortages during drought, while others have been due to imported fuel shortages driven by price hikes. Degraded power stations and slow-paced expansions have also been culprits of shortages. These crises have brought greater attention to the need for forward planning of a low-risk – or "no regrets" – national power sector to ensure that national planners address new risks – particularly climate change – as well as risks that have been historically overlooked. "No regrets" energy planning would identify project long-term risks and prioritise low-risk projects within the scope of the commonly used least-cost energy planning. The financial burden of fossil fuel imports and new attention to carbon emissions have helped many countries recognise the benefits of developing indigenous energy sources and diversifying their sources of energy supply. A diverse energy portfolio is an important way to hedge the risks of any one power supply.

This is particularly true for large-scale hydropower. Already, 11 African countries are more than 80% dependent on hydropower (EIA 2006). Countries including Cameroon, Ethiopia, Ghana, Kenya, Malawi, Tanzania, Uganda, Zambia, and Zimbabwe have all witnessed power shortages in recent years caused by droughts that reduced hydropower supplies (UNECA 2007). Such power crises have caused countries to sign expensive short-term agreements for diesel generators. However, significant pressure to develop large-scale hydropower projects as "least-cost supply", including for regional use, remains influential in Africa's overall energy planning. This attempt to exploit Africa's hydro potential is blind to several risks that could ultimately undermine the cost-effectiveness of these choices – namely, energy portfolio overdependency on hydropower and the impacts

of climate change – regardless of whether they are public or private. These projects also face the ongoing risks of corruption and mismanagement.

Renewable energy

Setting national targets for renewable energy can indicate a country's proactive vision for a diversified and sustainable power sector. National targets for renewable energy have been set by at least 12 African countries, although these targets may include large hydro: Algeria, Egypt, Kenya, Madagascar, Mali, Morocco, Nigeria, Rwanda, Senegal, South Africa, Tunisia, and Uganda. Egypt has a target to generate 20% of its energy from renewables by the year 2020. In 1994, the country's New and Renewable Energy Authority introduced the Bulk Renewable Energy Electricity Production Programme to target large-scale solar and wind power development. Egypt operates a 5 MW demonstration wind farm, with two 60 MW wind farms under construction.

A feed-in tariff can be one of the most dramatic catalysts to drive renewable energy projects. A feed-in tariff typically obliges grid utilities to purchase renewable electricity supplies from eligible projects and guarantees to the renewable supplier, grid access for the renewable energy supply, long-term power purchase contracts from the renewable project; and an equitable purchase price. The first African country to introduce a feed-in tariff was Mauritius, followed by Algeria in 2002, Uganda in 2007, Kenya in 2008, and South Africa in 2009. Egypt and Nigeria are both in the process of developing feed-in tariffs. Today, Mauritius generates 40% of the country's power from *bagasse* – agricultural wastes from its sugar industry – in part due to these policies.

The extent to which public electricity utilities are better placed to provide renewable energy sources than the private sector is a matter that has not been debated in any sustained way in the African context but should be a central part of any serious efforts to create "alternatives to privatisation" on the continent.

Energy efficiency

Investing in more efficient use of energy supplies could lead to significant cost savings and delay construction of costly new supplies. Initiatives for energy efficiency and demand-side management are increasing in popularity but are far from reaching their full potential in Africa. In 2008, CEB in Mauritius wrote that "[c]learly, the most environmentally sound, inexpensive and reliable power plant is the one we do not have to build because we have helped our customers to save energy" (2008, 4).

The electricity supply industry in Africa is also characterised by high system losses – power produced but lost during transmission and distribution. Compared with the international target of about 10%–12%, some

of the power systems in Africa record figures as high as 30% (Karekezi and Kimani 2002). Some of the best improvements in efficiency would be reduced load losses, often through maintenance and upgrading of the grid. There's no reason to invest in a new power source when an equivalent amount of power could be "found" by decreasing existing system losses by public service providers.

Electric lighting consumes more than 19% of the world's electricity and accounts for up to 10% of energy consumption. Aggressively replacing incandescent light bulbs with compact fluorescent lamps (CFLs) could reduce energy demand from lighting by nearly 40%. The World Bank, which promotes bulk procurement and distribution of CFLs, has helped finance distribution of 2 million CFLs in Ethiopia, Rwanda, and Uganda, in order to cut each country's peak demand by 100 MW, while the government of Ghana distributed 6 million CFLs on its own (World Bank 2008). A World Bank emergency loan to the Central African Republic, where electricity access is limited almost exclusively to the capital, includes US$300 000 for dissemination of 80 000 CFLs for an estimated savings of 2 MW. The Southern African Development Community has undertaken a three-year CFL dissemination programme with member utilities to disseminate over 40 million CFLs leading to 1 750 MW of avoided supply (SAPP 2009). Once again, public service providers can take the lead in energy efficiency.

Job creation

According to the International Labour Organization (ILO 2007), 37% of all Africans live in extreme poverty, down only 1% from a decade ago. In absolute terms, the number of Africans living in extreme poverty has actually grown by 55 million people during this time. There is strong consensus that sufficient, decent work opportunities across Africa are not being generated. Instead, more than 80% of Africa's workers remain in marginalised livelihoods, primarily in subsistence agriculture and the informal economy. Africa's youth – 15 to 24 years – is also growing much faster than jobs are being created. African youth unemployment averages 20%, double that of the overall average unemployment. Africa will need to create 11 million jobs every year until 2015 simply to achieve unemployment rates that match the global average of about 6%.

Much of the energy sector development to date has reflected the energy needs of commodity-based industrial development, which continues to drive economic growth in many African countries. However, high economic growth often narrowly reflects high prices and/or increased sales of commodity exports but with few jobs and limited benefits to the rest of the population. Too often, though, the energy sector does not respond to development goals for job creation or direct poverty alleviation.

New end-use industries are not the only way that energy plans influence job creation. The ILO also noted that the development of infrastructure can

optimise local job creation: "Ensuring strong linkages between infrastructure projects and local economies requires an equal investment in better social infrastructure facilities like support for rural micro, small and medium enterprises and cooperatives" (2007, 3). The ILO has also suggested that the march towards universal access to basic services creates jobs in the energy sector and beyond. But key opportunities are still being missed. In South Africa, a 2006 study by the International Development Corporation found that a significant portion of Eskom investments, including the use of public funds, was used to purchase imports, missing a key opportunity to use the investments to jump-start local manufacturing (UNECA 2007).

Many experts agree that the renewable energy sector, particularly energy efficiency, generates more jobs than in fossil fuels (*San Francisco Chronicle* 2004, ILO 2008). In South Africa, one study found that renewable energy sources would create three times as many jobs as relying on fossil fuels (AGAMA Energy 2003).

Smaller-scale, decentralised electricity systems can also create more manufacturing and maintenance jobs for local people. Two enterprises in Kenya have pioneered the local manufacturing of wind pumps and wind generators in the country: Bobs Harries Engineering Limited manufactures wind pumps for water pumping, and Craftskills Enterprises manufactures wind turbines designed to utilise less-powerful wind gusts. An estimated 90% of the materials used to manufacture the turbines are sourced locally; recycled metals are used to make the machines, and the only imported components are magnets (GTZ, n.d.). Craftskills provides regular technical maintenance and a hotline support desk for immediate problems. Companies like Deng Limited in Ghana and Zara Solar in Tanzania are local leaders in selling, installing, and maintaining solar PV systems and have received prestigious international awards for their accomplishments in sustainable energy (Ashden Awards 2007a, 2007b).

Building local capacity to analyse energy options and policy is also important to promote long-term sustainable provision. UNEP's Global Network on Energy for Sustainable Development (GNESD) has identified three "centres of excellence" in Africa – the African Energy and Policy Research Network based in Nairobi, Kenya; *Environnement et Développement du Tiers Monde* in Dakar, Senegal; and the Energy Research Centre at the University of Cape Town, South Africa. In West Africa, ECOWAS plans to set up a Regional Centre for Renewable Energy and Energy Efficiency. The government of Kenya also intends to set up a Centre for Energy Efficiency and Conservation.

Although no research exists as to the potential for job creation in renewables in the public versus the private sectors in electricity in Africa, it is arguable that coordinated public sector investment would create more jobs than ad hoc private sector investment.

Modern energy services for development

While this chapter is intended to focus on provision of electricity, the provision of other modern forms of energy can be equally vital to human and economic development in Africa and to the search for innovative public service provision. Energy needs for domestic use and for income-generating activities for Africa's rural majority are too often overlooked by state utilities and financiers focused on the electricity grid. In November 2009, the United Nations (UN) released a comprehensive review of targets set by African governments for access to electricity and other modern energy services, including access to mechanical power, modern cooking fuels, and improved cookstoves (Legros et al., 2009). These forms of energy services regularly lose out to electrification initiatives in the competition for scarce donor funds.

Even when electricity is available, it often does not displace traditional biomass use for cooking and heating. Approximately 579 million Africans – 76% of the rural population and 47% of urban Africans – rely on wood, charcoal, and dung as their primary sources of cooking energy (OECD and IEA 2006). Instead of switching energy use entirely to electricity as it becomes available, households add fuels in a process of "fuel stacking":

> Modern forms of energy are usually applied sparingly at first and for particular services rather than completely supplanting an existing form of energy that already supplies a service adequately. The most energy-consuming activities in the household – cooking and heating – are the last to switch. Use of multiple fuels provides a sense of energy security, since complete dependence on a single fuel or technology leaves households vulnerable to price variations and unreliable service. Some reluctance to discontinue cooking with fuelwood may also be due to taste preferences and the familiarity of cooking with traditional technologies. (OECD and IEA 2006, 422)

Using traditional biomass for household energy is a significant health issue. Pollution concentrations in rural African homes can be as much as 100 times higher than those observed in the urban areas of many industrialised nations (Kammen and Jacobson 2005). The World Health Organization (WHO) estimates that about 1.5 million people die each year from indoor air pollution caused by cooking with traditional biomass energy, with the heaviest proportion in sub-Saharan Africa. The lack of efficient energy sources also impacts health systems in the region (Enskat and Liptow 2008). Improved cookstoves are one form of modern energy service that could increase fuel efficiency and smoke departure of traditional biomass, thereby reducing both the demand for traditional biomass and health impacts.

The use of traditional biomass – primarily wood fuel and charcoal – is a significant source of environmental problems. As forest resources disappear a "fuelwood gap" is emerging. In Mozambique, for example, estimated total wood fuel consumption is about 640 m^3 per person per year. Illegal

logging to supply the urban charcoal demand is still widespread despite heavy fines (Greenpeace and ITDG 2002). This "traditional" energy source is seldom given high priority in energy policies or poverty alleviation strategies; there are few comprehensive national strategies for the traditional use of biomass in the energy sector (EUEI and GTZ 2008).

At least one-third of African countries have programmes for improved biomass cookstoves, and many more have pledged to help develop the technology, spread information, foster projects, and generally promote access to modern cooking energy for rural populations currently using traditional biomass. More than 8 million improved stoves are believed to be in circulation. Kenya has been the leader, where the Kenya Ceramic Jiko stove is found in more than half of urban homes and roughly 20% of rural homes. A significant number of improved cookstoves are also reported in Burkina Faso, Eritrea, Ethiopia, Ghana, Niger, Senegal, South Africa, Tanzania, Uganda, and Zimbabwe (REN21 2008). A number of African countries have set targets for increasing access to modern cooking fuels and improved cookstoves.

Solar PV and wind power for pumping both irrigation and drinking water are gaining widespread acceptance, and many more projects and investments are occurring. Large numbers of wind pumps for water are being used in Africa, including 300 000 in South Africa, 30 000 in Namibia, 800 in Cape Verde, 650 in Zimbabwe, and roughly 2,000 more across several other countries. There are an estimated 1 000 solar water pumps in use in West Africa. Donor programmes for PV-powered drinking water have appeared in Namibia, Niger, Tunisia, and Zimbabwe (REN21 2008).

THE WAY FORWARD

Africa remains the world's most concentrated population lacking access to electricity. This chapter provides a framework and some examples that demonstrate how public, community, and other non-commercialised systems will be fundamental for providing widespread access to electricity on the continent. A rethinking of the power sector reforms that have guided the unsuccessful shift towards privatisation is necessary, and a review of the social welfare goals – particularly encased in the Millennium Development Goals – will be important. How many more creative minds like William Kamkwamba could be empowered to make energy innovations with local resources? What needs to be done to tap into this drive to bring electricity to communities, schools, and homes? How can this be done without relying on privatisation and commercialisation?

Based on the information presented in this chapter, the following actions are suggested:

- Given the history of poor service, state provision of electricity cannot be successful without holding governments and utilities accountable

and ensuring that they create an enabling environment for successful public and community provision. Greater transparency of state-based electricity systems, targets, finances, and planning processes will allow greater accountability by communities and civil society, as well as by the donor community. As states increase their engagement in regional energy planning, they should ensure civil society participation in regional planning and public accountability of decisions.

- Power sector reforms should be pro-poor as well as improve technical and financial management. Structures and mechanisms to address rural electrification should be prioritised prior to privatisation, or else rural electrification may not be addressed at all. Reforms should also adopt innovative approaches to meet electrification targets.
- National Electricity Acts should establish autonomous oversight for rural electrification funds.
- Data collected on access to energy should be standardised and include sufficient data to allow analysis of socio-economic factors. For example, data collected on new connections should differentiate between rural and urban households. Evaluations of utilities and rural electrification agencies should reflect data on the number of new connections.
- Economic development in Africa needs to be pro-jobs and pro-poor. Successful electricity provision should reflect national energy strategies that support industries that create decent jobs, build community resilience, and do not threaten food security; this should be prioritised for local communities in both urban and rural areas. Focus should include the agricultural value chain and manufacturing. Local production of energy inputs and systems using local materials and local technical knowledge should also be prioritised.
- Empowering and enabling communities to be active participants in the electrification process is one of the greatest oversights to date. Communities can and should take action towards electrification. States should publicise their targets and involve the public in monitoring progress. States should reduce regulatory barriers for communities and enable state financial support for communities.
- African energy ministers have provided a great gift: time-based targets for electrification. Civil society should use these government-generated targets to hold their officials accountable and to work with government and donors to ensure that resources are well allocated for these targets.
- In many identified community experiences, a common challenge has been creating and maintaining a management system for the electricity service provider. Many examples identified some form of an elected consumer committee responsible for technical and financial operations. There is a particular need to create ways to share information across community experiences and generate greater awareness for existing examples. Building a knowledge base of examples and experts is an

effective way to share information between countries and communities. The Internet and social networking offer a myriad of ways to gather data, share experiences, and monitor government targets.

- Political will to electrify African communities is lacking. Africans will need to generate political will through public action. Sharing stories of successful community systems and building networks of activists and technicians can strengthen public and community movements towards energy development and help demonstrate the endless possibilities of community-driven power. To advance advocacy, more education is needed around national energy planning and institutions, understanding targets, advocating to national regional and continental institutes, and financiers.
- Renewable energy sources will be an important part of the solution to diversify Africa's energy portfolio. An effort led by the African Union to produce a continent-wide African Energy Vision 2030 is under way. This could be a key place to promote renewable energy targets. Developing a range of power sources of different scales can also help hedge risks and bring power sources closer to the people, enhancing the "public" nature of service provision.

NOTES

1. GEF is an intergovernmental funding initiative established to improve the global environment. Since 1991, the GEF has allocated $8.8 billion for more than 2 400 projects. The 18 systems noted here were funded through GEF's Small Grants Programme, which has made more than 10 000 small grants to non-governmental and community organisations (GEF, www.thegef.org/gef/whatisgef).
2. Barefoot College. www.barefootcollege.org/sol_work.asp (accessed 15 September 2010).

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