Enhancing access to electricity for clean and efficient energy services in Africa.

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Contents

Preface

(to be completed)

Executive Summary

In the developed world energy is almost universally available and accessible: light at the flick of a switch, heat for cooking or comfort at the turn of a knob. In many parts of the developing world the picture is very different. In most African countries the larger part of the population has no access to electricity and many have only limited or no access to cleaner and more modern fuels such as kerosene, liquefied petroleum gas (LPG) or natural gas.

More than 500 million Africans have no access to electricity and unless dedicated national efforts are implemented with major international support, the situation will only get worse and in 10 years half of the people in the world without access will be on the African continent

The MDG Review Summit in 2010 emphasized in the final report - *"the importance of addressing energy issues, including access to affordable energy, energy efficiency and sustainability of energy sources and use, as part of global efforts for the achievement of the Millennium Development Goals and the promotion of sustainable development."*

For access programmes to be sustainable it is important that they make provisions for energy for both basic services and productive uses in order to improve livelihoods and also help drive local economic development on a sustained basis. Electrification programmes should therefore be combined with a strong development focus and target productive sectors as well as households and social services. National programmes should have a strong focus on the demand rather than the supply side, and devote attention to the energy services to be delivered rather than the megawatts to be built.

Several renewable energy technologies can contribute to central grid, local mini grid and off-grid provision of electricity, and in addition a number of technologies can provide energy for specific services directly. Most renewable technologies have potential for engaging local communities and businesses in production and maintenance of equipment and installations.

Some African countries have been very successful in moving away from a low and stagnant level of electrification and within a relatively short time span moved up to a significantly higher level. These cases have been analysed and findings form the basis for the recommendations in this paper.

Recommendations and key issues at the national level include:

- ***Strong and sustained government support*** is the single most important pre-condition for a successful access programme
- ***Having a strong central institution in charge*** of the overall electrification programme, either in the form of a government agency, utility or a dedicated independent institution
- ***A nationally integrated electrification and development plan*** covering a span of several decades needs to be developed as basis for prioritization of actions
- ***Grid extension and off-grid solutions*** need to be considered in an integrated manner and may very well be implemented in different parts of the country in parallel

- ***Gradual build up and structured transitions*** should be the foundation for access expansion in a manner that accommodates the ability of different target groups to adopt electricity
- ***Strong engagement of local communities*** is crucial for successful implementation and longer term management of local electricity supply
- ***Financing for access programmes*** will need to be scaled up significantly both nationally and internationally, and business models need to be developed to utilize public private partnerships in ways adapted to the local context
- ***Subsidies and social tariffs are necessary*** to implement access programmes. Tariffs need to be designed to make it possible for the targeted customers to connect and use the provided resource. At the same time tariffs and subsidies in combination need to ensure full cost recovery for the delivered service to make the provision viable in the longer term.
- ***Strong potential for renewable energy*** technologies to contribute significantly to electrification both via grid extension and through mini-grid and off-grid systems.
- ***Focus on productive uses and employment generation*** is crucial for access programmes to have a chance of achieving the targeted economic development benefits
- ***The international community can play an important role*** especially in creating political awareness around the development benefits of enhanced access
- Donor support will be crucial for
    - ***Strengthening the institutional structure for planning and implementation*** at both national and local scale, including specific support for increasing the renewable energy uptake in programmes
    - ***Contributing to the sustained financing*** of required subsidies for access programme expansion and tariff structures that will actually allow the targeted poorer part of the population to benefit fully
- ***Donor coordination and coherence, both internal and external,*** will be essential to ensure consistent and sustained support for nationally led access programmes.

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Acronyms

ADB	Asian Development Bank
AFD	L'Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
AGECC	Advisory Group on Energy and Climate Change
CLUB-ER	The Club of National Agencies and Structures in charge of Rural Electrification
EIB	European Investment bank
ESMAP	*Energy Sector Management Assistance Program*
EVN	Vietnam Electricity
FBE	Free Basic Electricity
GEF	Global Environment Facility
GIS	Geographical Information System
GNESD	Global Network on Energy for Development
GoG	Government of Ghana
IEA	International Energy Agency
INEP	Integrated National Electrification Programme
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied Petroleum Gas
LV	Low Voltage
MDG	Millennium Development Goals
MoE	Ministry of Energy
MSE	Micro and small-scale enterprises
MV	Medium Voltage
NEF	National Electrification Fund
NEL	National Electrification Levy
NELF	The National Electrification Forum
NEMP	National Electrification Master Plan
NEP	National Electrification Programme
NEPS	National Electrification Planning Study
NES	National Electrification Scheme
NGO	Non Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
PC	Power Corporations
PERG	Global Rural Electrification
PPA	Power Purchase Agreements
PPP	Public Private Partnership
PURC	Public Utility Regulatory Commission of Ghana
PV	Photovoltaics
PVER	Valorisation de l'Electrification Rurale
RDP	National Reconstruction and Development Programme
RE	Renewable Energy

REA	Rural Electrification Agency
REF	Rural Electrification Fund
REF	Rural Electrification Fund
RESPRO	Renewable Energy Service Project
SHEP	Self Help Electrification Programme
SHS	Solar Home System
SME	Small and Medium sized Enterprises
SWER	Single Wire Earth Return
UNDP	United Nations Development Programme
WB	The World Bank
WEO	World Energy Outlook

1 Background and context

In the developed world energy is almost universally available and accessible: light at the flick of a switch, heat for cooking or comfort at the turn of a knob. In many parts of the developing world the picture is very different. In most African countries the larger part of the population has no access to electricity and many have only limited or no access to cleaner and more modern fuels such as kerosene, liquefied petroleum gas (LPG) or natural gas. The situation is not unique for the African region, as will be discussed in more detail in Section 1.1, but the unique challenge for the region is the large number of countries with limited access combined with the extremely low electrification levels in many of the countries. This paper focuses on electrification in Africa in order to try to address the specific challenges facing many of the countries in the region.

The concentration on electricity is not meant to imply that other options for clean energy, like efficient stoves, LPG, mechanical Renewable Energy (RE)[1] technologies etc. are not equally relevant for many needed services. For most countries the "ultimate objective" is to provide electricity to the whole population, so electrification is especially relevant. In addition, the whole set of energy access issues is immensely complex and beyond the realistic scope of a short study like the present one. In spite of this focus on electricity and Africa, many of the issues discussed and recommendations made are, nevertheless, equally relevant for non-electrical options and also for countries in other regions aiming to increase access.

Even if Africa is the region with the lowest level of access to modern energy services and especially electricity, the situation varies immensely between countries and as input to the paper a number of case studies have been solicited. The papers focus on providing a better understanding of the key driving factors in those countries where rapid progress on electricity access has taken place in the last couple of decades. The case studies, summarized in Chapter 3, offer a number of valuable insights into the national programmes and approaches, which combined with the generally available literature, provide a solid foundation for presenting a number of recommendations for national governments and the international community on how to move rapidly forward with large scale energy-access programmes.

1.1 Overview of the access situation

With the energy access issue gaining increased global political prominence in the last years, the global numbers have become regularly quoted in policy discussions as well as in interested media. A number of institutions have undertaken dedicated efforts to improve the understanding of the current situation concerning access to electricity as well as modern cooking fuels. In this paper the numbers provided by the International Energy Agency (IEA) are quoted for several reasons. The IEA has made a remarkable effort the last years to improve their data for non-OECD member states, including a significant effort to improve the understanding of the energy access situation and challenges. Another more pragmatic reason for using only IEA numbers is that there is a large element of internal consistency on data which by nature is highly uncertain.

It is important, however, to emphasize that the IEA numbers are not considered more or less precise than any other global numbers regarding energy access, and the actual situation on the ground may differ significantly for a number of reasons of which only a few are listed here as examples:

- Very few of the countries with low levels of access have energy data as part of any national statistical census activities, so most numbers are scaled up from limited case samples
- Utility data in many countries is not detailed enough to provide information about consumer categories or their consumption levels
- Large population groups live in informal settlements, often with no legal status and typically with significant mobility.
- Definitions of access vary between data sources and even if numbers on electricity connections were correct, they do not indicate anything about supply availability or affordability.

Thus, global and often even national numbers need to be used with a large degree of caution for practical planning purposes. One of the first efforts of any access programme is to get a clear and precise idea about the actual situation on the ground.

The inclusion of the well known global data obviously does not provide any new revelations, but is cited to recall the magnitude of the global problem and to provide a clear rationale for the focus of the paper on the African region.

Table 1.1: Millions of people without access to electricity in 2009 by region; projections to 2015 and 2030 under the IEA World Energy Outlook 2010, New Policies Scenario; and percentage of total populations with future access as a result of anticipated electrification rates[2]

	2009			2015	2030	2009	2015	2030
	Rural	Urban	Total	Total	Total	%	%	%
Africa	466	121	587	636	654	42	45	57
Sub-Saharan Africa	*465*	*120*	*585*	*635*	*652*	*31*	*35*	*50*
Developing Asia	716	82	799	725	545	78	81	88
China	*8*	*0*	*8*	*5*	*0*	*99*	*100*	*100*
India	*380*	*23*	*404*	*389*	*293*	*66*	*70*	*80*
Other Asia	*328*	*59*	*387*	*331*	*252*	*65*	*72*	*82*
Latin America	27	4	31	25	10	93	95	98
Developing countries*	1229	210	1438	1404	1213	73	75	81
World**	**1232**	**210**	**1441**	**1406**	**1213**	**79**	**81**	**85**

*Includes Middle East countries; **includes OECD and transition economies.

The IEA figures for 2009 and projections up to 2030 (with planned policies but no dedicated additional access efforts) show that the number of people with no access to electricity is expected to remain quite stable in the next decade, but the African region will increase its share quite dramatically, especially with countries in Sub-Saharan Africa.

While the numbers are challenging they do conceal the fact that populations grow and therefore many people will actually gain better access in the coming years. For example, in the 1990s more than 250 million people gained access to electricity, mainly in China. However, current rates of electrification on the African continent are barely coping with the population increase and without dedicated policy efforts and international support it will be impossible to make any significant dent in the number of people with no electricity access.

When examining the number of people who still rely on traditional biomass for cooking purposes (Table 1.2), it is apparent that electricity access in no way indicates that households are able to use electricity for all energy service requirements. The reasons are many, but typically relate to affordability, lack of stable supply or inability to purchase equipment like cookers, etc.

The fact that that the number of biomass users in Africa does not differ very much from the number without electricity, when compared to the situation in Asia, is most likely attributed to the very low electrification level in rural areas in the African region rather than any structural differences in electrification approaches between regions.

Table 1.2: Number of people (millions) relying on traditional biomass for cooking 20092

Region	Total
Africa	**657**
Sub-Saharan Africa	**653**
Developing Asia	**1937**
China	**423**
India	**855**
Other Asia	**659**
Latin America	**85**
Developing countries*	**2679**
World**	**2679**

*Source: IEA 20102. * Includes Middle East countries, ** includes OECD and transition economies*

The uncertainty relating to the biomass users is probably even higher than for electricity and recent studies by the Global Network on Energy for Sustainable Development[3] show that many households, especially in poor urban areas, rely on a number of different cooking options including woodfuel, kerosene and, in some countries, also LPG. The actual use depends on income variations, supply availability, etc. The study showed that if a household experiences a period with steady income, it tends to shift to higher quality fuels but often shifts back, if the LPG or kerosene supply is unstable or if income goes down due to seasonal variations or change in employment

The dimension of gender is also important here, and the link between gender and energy access continues to receive important attention, for example through the Energia Network[4]. It has been well known for many years that many of the negative effects of low-quality fuel use (woodfuels, crop residues, animal waste, etc.) in developing countries impact on women, and the young children in their

care[5]. In addition, the burden of gathering biomass fuel as well as carrying water, often falls on women and girls. Clean and affordable energy access, both for thermal purposes like cooking and motive power for water pumping, milling, etc. can alleviate these burdens and have an important impact on achieving the MDGs, as described in the next section. The gender dimension in energy access is not, however, limited to alleviating burdens on women, but through productive uses can also be an important driver of income generation and development. This is discussed in chapter 2.

1.2 Importance of Access for MDG achievement and social and economic development

The understanding of the crucial role of energy for poverty eradication and achievement of the Millennium Development Goals (MDGs) has been researched extensively over the last decade. Using another example from GNESD[6], Table 1.3 shows a number of specific areas where energy services are critical for addressing the MDGs.

Table 1.3: The role of energy and scope of policy interventions for achieving and sustaining the MDGs

MDG	Indicator	The role of Energy	Energy needs and policy interventions for meeting and sustaining the MDGs
1. Eradicate extreme poverty and hunger	• Proportion of population <$1/ day • Poverty gap ratio • Share of poorest 20% of society quintile in national consumption. • Prevalence of • under-weight children < 5 • Share of population below minimum dietary consumption. • Share of population suffering from water-borne diseases	• Access to energy services facilitates economic development - development of micro enterprises, livelihood activities, locally owned businesses that create employment, and so on - and assists in reducing extreme poverty • To reduce hunger and improve access to safe drinking water, energy services can provide pumped water and fuel for cooking 95% of the staple food.	• Post-harvest processing for home consumption and for generating surplus • Support improved nutrition • Improve supporting infrastructure and services to properly utilized surplus • Enhance income generating activities
2. Achieve universal primary education	• Net enrolment in primary • education • Share of pupils finishing primary school • Literacy rate among 15-24 years	• Energy services reduce time spent by school-going children (especially girls) on basic survival activities (gathering firewood, fetching water, cooking, and so on) • Lighting permits home study, • increases security, and enables to use educational media and communication in schools	• Electricity for teaching aids • Improved energy efficiency in school buildings • Free children from the drudgery of fuel collection
3. Promote gender equality and empower	• Girl/boy ratio in school	• The use of improved	• Provision of better

women	and tertiary education • Literate women/men ratio for 15.24 years • Share of women in wage employment • Share of women in parliament	devices reduce the household burdens of girls, making them stay in school longer; they also have the time to do school work at home	cooking fuels to reduce indoor air pollution • Access to mechanical energy for women

Source: GNESD 20076

The examples in the table are in no way exhaustive but simply illustrate some of the typical areas where improved access to modern energy services can contribute to addressing the underlying problems related to MDG achievement. Many other examples and research findings could be quoted, but instead the issue is nicely captured by the report from the MDG review summit in 2010[7] where it is stated:

"*We emphasize the importance of addressing energy issues, including access to affordable energy, energy efficiency and sustainability of energy sources and use, as part of global efforts for the achievement of the Millennium Development Goals and the promotion of sustainable development*."

In the same study, GNESD also addressed some of the broader "myths and realities" linked with the political and public understanding of energy access. The listing has been adapted and expanded here as an entry point to the discussion of the need for a more differentiated understanding of the access issue.

Table 1.4: Common Energy 'Myths' and Clarifications

Myth	Reality
The poor do not consider access to energy as a priority	The poor may not use the term "energy" but they often spend far more time and effort obtaining energy services compared to the richer section of the population. They often spend a substantial proportion of their household income on energy for basic needs like lighting, cooking, keeping warm, etc.
Poor people cannot pay for their energy services.	Many poor people pay more per unit of energy than the better off, partly due to small and costly fuel purchases, inefficient conversion equipment and pricing policies
Access to electricity, grid or decentralized, will by itself address all the energy needs of the poor	People need to access a range of energy services to satisfy their energy needs, including lighting, cooking, heating, transport, and communication. Electricity can make an important contribution but is not the only solution.
Access to modern energy services will by itself stimulate economic development	Improved energy access can be an important enabler for local economic development, but it only a necessary not a sufficient component for local development and needs to be combined with dedicated cross sectoral development efforts

Only rural areas suffer from lack of access to energy	Poor people in urban and peri-urban areas also suffer from lack of access to modern energy services, and the number will increase with rapid urbanization. It is expected that almost 50 % of the people in the African region will be living in urban and peri-urban areas by 2030
Commercial energy required to satisfy the needs of the poor is significant with respect to total global energy consumption	Reaching the poor with basic modern energy services over the next two decades would, depending on approach used, according to the IEA only increase commercial energy consumption by around 1% and the same applies to global GHG emissions

Source: GNESD 20076

While the table provides a somewhat simplistic and popular way of addressing some serious issues, the aim is to move quickly beyond the often quite generic understanding of energy access, which is reflected in many recent policy statements.

From practical experience over a couple of decades, available literature and the underlying case studies it is clear that there are no simple or generally valid solutions to the issue of providing access to clean and efficient energy services. Efforts need to be targeted to specific national and local circumstances. However, in order to be successful it is important at the same time to utilize the opportunities of a global scale up of access efforts to drive down costs of a number key technologies and services whenever possible. This is especially important where elements of standardization and larger-scale equipment production can be applied successfully.

It also has to be emphasised that, while improved access is mainly a rural issue, it is also relevant for urban settlements and peri-urban slums around the larger cities. Table 1.1 shows that currently over 200 million urban inhabitants lack access and with rapid urbanization over the next two decades, this number is expected to grow rapidly. The case studies show that implementation of successful access programmes need to differentiate not only between national settings but develop tailored approaches to address the differences between access issues and options in settings that vary from really remote small rural settlement to townships, minor cities and large peri-urban slums. To do this successfully will require both improved understanding of the current energy service and fuel use situation, and development of more integrated approaches, possibly including elements of planned transition of electrification; for example from initially providing better access to individual services like lighting based on PV home systems to building local mini grids, and potentially in the longer term, linking these into a national grid.

In addition to physical and technological aspects, a better understanding of the income differentiation in the relevant population groups will also be required in order to target financing and tariff solutions, for example using market-based approaches in situations where the current energy supply is largely monetized. This may be combined with carefully targeted subsidies where required, in order to make access affordable for very low income groups.

The need for such differentiated and transitional approaches will be further discussed in Chapter 2 along with a more principle introduction to different access definitions and how they relate to the social and productive aspects of development.

2 Understanding of access and energy services

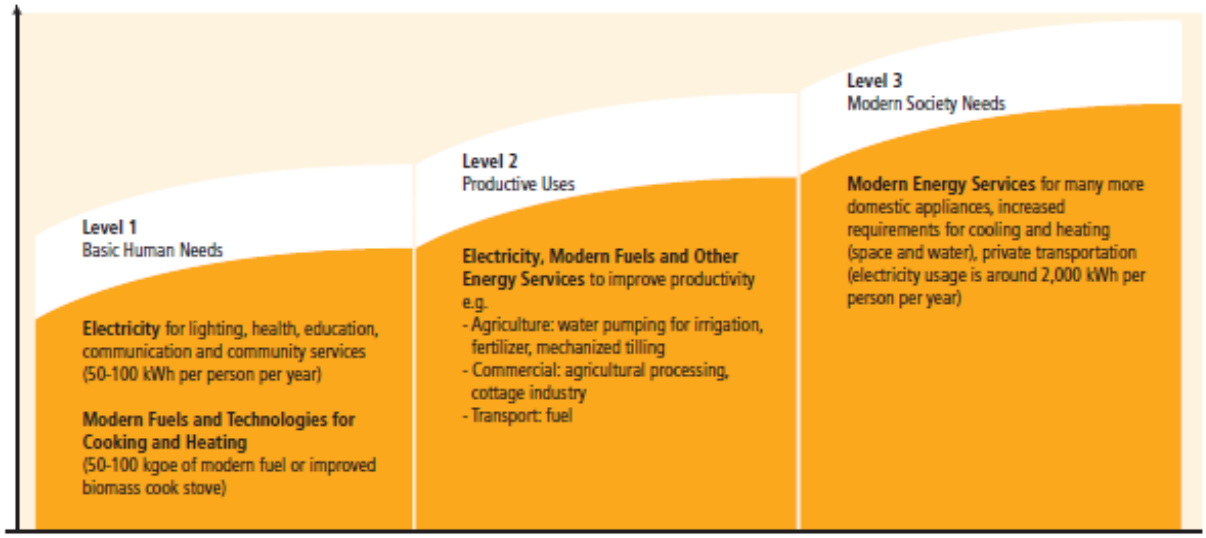
2.1 Establishing a common understanding of access

The first basic issue that needs to be addressed when discussing enhanced energy access is to have some form of common understanding of what is meant by having access and implicitly "access to what?"

A number of access definitions exist, ranging from numerical minimum requirements to social and economic criteria[8]. For the purpose of this study the definition put forward by the UN Secretary General's Advisory Group on Energy and Climate Change (AGECC) in their 2010 report[9] has been adopted.

The AGECC definition is stated as "access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses" illustrated as Level 2 in Figure 2.1. The AGECC approach illustrates that access is often an incremental process starting with focus on servicing basic human needs, but needs to move further to create a self sustaining process based on local economic development.

Figure 2.1: Access levels and underlying services



Source: IPCC SRREN 2012[10]

Even the basic Level 1 energy access which includes lighting and provides for communication, healthcare and education can provide substantial benefits to a community or household, and with the right pricing

structures it can even include cost savings. The important point made in the AGECC report, however, is that, if the energy services are both to improve livelihoods and help drive local economic development on a sustained basis, then the appropriate level to define access is the provision of energy for basic services and productive uses.

In order to design effective access programmes, it is important to have a clear understanding of the types of energy services that are demanded by the targeted communities. Reflecting the access structure presented above, demand can be usefully grouped into three categories:

- Household energy services, such as lighting, cooking, water heating, space heating or cooling, communication, etc.
- Productive or enterprise energy needs, including crop processing, water pumping, industrial machinery, other motive power uses, etc.
- Energy for social or community purposes, including schools, hospitals, water supply, communication systems, etc.

Transport is often not considered when analyzing energy access, but the availability of transport services is clearly an important parameter in integrated rural and urban development and the AGECC does in fact include transport fuel as part of the access definition.

With the basic access definition and understanding of service needs in place, the next step is to move from having access to ensuring that the targeted beneficiaries actually can and do use the opportunities provided, so the desired impacts on livelihoods and economic development occur in practice.

Three key terms most commonly used are *accessibility, affordability and availability*. Linking the terms to electricity provision, the first aspect is to provide physical access to power in some form. Second is to ensure that the user can afford not only the power provided but also the necessary connection costs and appliances required to make efficient use of the electricity. Finally the supply needs to be available and reliable so that consumers can depend on it for the required services.

Accessibility and affordability is discussed in more detail in the following sections while availability and reliability issues are not addressed directly but are covered in the general discussion about supply options. As an illustration of the importance of the issues, Table 2.1 illustrates the consequences associated with unreliable supply.

Table 2.1. Indicators of the reliability of infrastructure services

	Sub-Saharan Africa	**Developing Countries**
Delay in obtaining electricity connection (days)	79.9	27.5
Electrical outages (days per year)	90.9	28.7
Value of lost output due to electrical outages (percent of turnover)	6.1	4.4
Firms maintaining own generation equipment (percent of total)	47.5	31.8

Source: IEA, 20102

The economic consequences for domestic consumers and private companies are not monetized, but the numbers clearly illustrate the problems directly related to outages and the reaction by many customers to purchase their own generators which is not only an additional investment but often provides much more costly supply.

2.2 Towards an "energy plus" approach

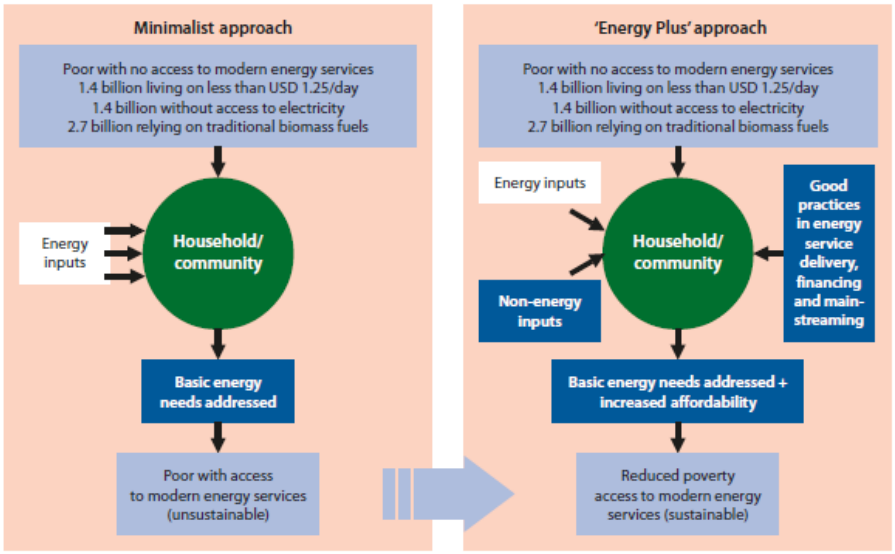
Building on the AGECC access definition and its focus on inclusion of productive uses, it is important to acknowledge that most experience shows, and a number of studies have documented (summarized by Bernard 2010[11]), that provision of electricity or other modern energy services does not on its own lead to economic development. Electricity is often seen as a necessary condition for stimulating economic activities, but it is not sufficient. Provision of electricity access needs to be combined with other types of action in an integrated development plan for the targeted area to realize the potential benefits associated with improved access in the current political rhetoric.

In a recent report, UNDP introduces the concept of an "energy plus" approach[12] in which provision of energy access is combined with other enabling inputs like:

- infrastructure (e.g. roads and communications);
- access to markets;
- access to capital;
- availability of information and skills training; and
- social services such as medical facilities and schools

Figure 2.2 illustrates the "energy plus" approach compared with what in the UNDP report is called the minimalist approach, which is actually more a business as usual approach with infrastructure expansion seen as key to development.

Figure 2.2: The 'Energy Plus' Approach



Source: UNDP 2011[12]

The importance of these enabling inputs will vary between rural and urban access programmes. The UNDP study has examined 17 energy-access programmes in the Asian region and largely reaches the same conclusions as the WB study[11] of impacts of electrification projects in Sub-Saharan Africa where electrification programmes have mainly brought social benefits in the form of better lighting, communication and information along with improvements in education and health where power has improved schools and hospitals. The studies generally show , however, that improvements in incomes and livelihoods are less clear. Some few programmes have taken a more integrated approach and here UNDP clearly finds that it is possible to document positive impacts on poverty reduction, economic and human development and that programmes have become self sustaining.

The studies consistently point towards strong involvement of local communities in the planning and implementation of access programmes as one way of strengthening the development aspects.

2.3 Linking supply options and service needs

The diverse set of energy services required for household, productive and social uses can be supplied in many different ways. Electricity has, however, a number of attractions, as it is the most flexible energy carrier and can be utilized for virtually all required services. In addition, it can be produced on the basis of a large number of different energy sources and readily transmitted over long distances. The focus of this paper is therefore on electricity, as already stated above. However, it has to be re-emphasised that it is still a small minority that has access to electricity in most countries in the African region as shown in Table 1.1. Providing universal access to electricity in the region presents an immense challenge both technically, economically and institutionally, as will be discussed further in the following chapters.

When discussing how to begin to address this challenge it is essential to focus on realistic and pragmatic approaches. These approaches must embody optimal combinations of the three ways of providing access to electricity, reflecting specific country and local conditions:

- Extension of the central grid
- Establishment of local mini-grids
- Off-grid options

One of the key premises of this paper is that the access challenges can best be addressed in an incremental way, making optimal use of gradual transitions, both from one level of access to the next and from individual supply options to integrated systems. How best to do this depends strongly on the local settings and evidently differs tremendously between remote rural areas and peri-urban settlements.

Common to all contexts, however, is the need to start from a strong focus on the demand rather than the supply side, and focus on the energy services to be delivered rather than the megawatts to be built. How to build the supply infrastructure and find the optimal combination of sources will have to be carefully designed too. In reality many national planning processes have pragmatically to address both bottom-up energy service needs and top-down expansion of supply options based on the existing infrastructure.

In order to provide a shared understanding of the focus on services and the need for a transitional process, the following sections discuss briefly some of the main household services, how they are currently served, options for a change towards cleaner and more efficient service provision and how electricity and other modern options can interact to facilitate a gradual move away from the traditional supply options with the ultimate but often distant option of full electrification of all services.

Cooking is traditionally done using woodfuels where the distribution between fuelwood and charcoal depends on the specific local circumstances. Peri-urban areas and townships with limited access to forests generally rely heavily on charcoal markets, while fuelwood plays a larger role in rural areas depending on local availability. Relatively few areas in the region are in a situation where collected wood is readily available, so some elements of fuelwood markets exist in most countries and households, institutions and small business collect or buy depending on the time requirements related to collection, availability of income etc.

Lighting in low-income areas is traditionally provided by the cooking fire, candles or by kerosene lamps while mechanical power is mostly provided by animal or human sources.

Since most low-income customers purchase small quantities of fuel, the price per unit is usually quite high. Combined with low efficiency of the stove, traditional cooking arrangement or lamps, this means that the effective energy cost for the poorest part of the population is the highest of all.

The need to provide better cooking solutions is compounded by the serious health problems related to poor combustion of biofuels where it is expected that around 1.5 million premature deaths[2] are associated with the effects of air pollution from burning of domestic woodfuel.

Significant efforts over recent decades have been devoted to development and dissemination of more efficient stoves, in some cases combined with chimney arrangements. Some programmes like the so-called Ceramic Jiko in Kenya, which may increase efficiency of charcoal use by up to 30 to 50% compared with traditional stoves, have reached high penetration rates of up to 50% in peri-urban areas in Kenya and are now gradually spreading to other African countries.

No overall numbers exist on the application of efficient stoves, but with more than two and a half billion people still cooking on solid fuels the urgency of global action is pressing. The new initiative on a global alliance for clean cookstoves launched by the UN Foundation in collaboration with a large number of partners is therefore addressing a pressing need, and the target of reaching 100 million households in a decade is a highly commendable effort, which if successfully implemented will make a significant contribution to improving livelihoods and reducing pressure on woodfuels.

Cooking with electricity would evidently be significantly more efficient and clean, but as the data in Section 1.1 shows, the issue of electricity for cooking purposes poses some specific challenges compared to lighting and communication. The main challenge is that while lighting only requires power capacity from tens to a few hundred watts, it is necessary to have around ten times more for cooking purposes. This has implications both for the household connection cost, wiring and ultimately for the scale of the power source. In addition the cost of even simple cooking equipment and new pots is much higher than

simple light fixtures and bulbs. Combined with often poorly designed tariff structures for small scale consumers these constraints are the major reasons that over one billion people who do have electricity connection still rely on solid fuels for cooking purposes.

In addition to improving biomass cookstoves there are two other important options for cleaner and more efficient cooking. The use of kerosene stoves is already widespread in both Asia and Africa. Many households shift between the use of kerosene and woodfuel cooking devices depending on supply availability of either of the sources and household income fluctuations. Similarly Liquefied Petroleum Gas (LPG) is used for cooking in a number of countries. Brazil has very extensive use of LPG and other large economies like India and to some extent China have widespread use of LPG based on subsidized national or regional programmes. Around twenty African countries have implemented some types of LPG programmes for cooking, mainly in urban areas. In Senegal, Mauritania, Lesotho and Cameroon more than ten percent of the population use LPG[13] while the other countries generally have small programmes.

Although many developing countries in this way have access to LPG, the applicability of the technology to the rural poor is hampered by the required facilities and distribution systems plus the increasing prices of fossil fuels internationally. Distribution problems related to the poor quality of roads and relatively high per capita costs if the population density is low.

The elaborate discussion of stove issues is not intended to shift the focus of the paper from electricity access, but it illustrates very clearly the heterogeneity of the current energy use patterns and the fact that electricity supply in many instances co-exists with a number of other energy sources, for the reasons outlined above.

This situation presents both a barrier and an opportunity seen from an electrification perspective. The barrier is of a somewhat positive nature as the introduction of cleaner and more efficient energy sources like LPG and kerosene may reduce the interest in and economic ability to use a possible electricity option, if it becomes available, but the new cooking devices still provide a positive step forward in the provision of cleaner and more efficient energy services.

The specific opportunity stems from the fact that with these close links between sources and services, it is possible to introduce electricity in a gradual fashion, if this is desirable, starting with limited supply for lighting and communication and gradually expanding to eventually providing all the desired services. This is in fact the situation in many countries where small household systems or limited capacity grid connections provide this first step.

These aspects will be discussed in more detail in Chapter 4 in terms of how to establish transitional electrification schemes and what this requires with regard to more integrated planning, compared to the current situation in many countries where planning and implementation is often quite fragmented.

2.4 Productive energy use, poverty alleviation and gender issues

Energy is an essential input in one form or another to most micro and small-scale enterprises (MSEs)[14] that constitute a major potential for income generating and economic development of poor people in Sub-Saharan Africa. The importance of the energy dimension in the economic upliftment of the poor, especially the rural poor, has been discussed recently for example by Practical Action[15]. In many of these MSEs moreover, women play active and leading roles. The energy service needs of MSEs differ according to the particular activity, scale of operation and tradition. In general, energy services requirements for MSEs may be distinguished as:

- process heating and cooking
- mechanical processing
- cooling
- manufacture and repair
- powering ICTs

The extent to which males, females or both are involved and affected often varies with the type of energy service involved. Thus women are often disproportionately represented in enterprises that are related to cooking, hairdressing, clothes washing and tailoring. The availability of clean cooking fuels can therefore have a big effect on women here, and likewise the availability of electricity for cooling and small machines like sewing machines can provide important inputs for income generating. Heavy machinery, machine tools for carpentry and repair equipment like electrical welding sets are usually the domain of men, so provision of electricity for such uses would favour enterprises that involve men.

As always, the situation is a complex one, and the provision of energy is an essential but not sufficient input for enterprise development and the empowerment of women. What is important is to be aware of the central role of energy provision in the development and support of small enterprises, and especially the different roles of men and women with regard to use of the different energy forms and services, and the decision making processes involved.

2.5 Specific ways renewable energy can contribute

Few national electrification programmes in Africa have focused on renewable energy, apart from those countries where large hydropower plants provide the major share of their central grid supply. This situation is changing in many countries as a result of a number of factors, especially the rapidly rising cost of fossil fuels where oil important countries in the region can spend up to between 25 and 50% of their expert income on fossil energy imports. The improved competitiveness of many renewable energy technologies also plays a strong role for new political attention along with efforts to develop better data on availability and reliability of renewable energy resources like wind, solar and geothermal. A number of African countries now have some form on renewable energy target for either energy supply generally, electricity or for biofuels, although many of these targets are not backed by policy implementation so they remain political ambitions.

Several renewable energy technologies can contribute to central grid, local mini grid and off-grid provision of electricity, and in addition a number of technologies can provide energy for specific services directly. The case studies presented in the next chapter show how renewable energy can play an important role for electricity access solutions while table 2.2 below from REN 21[16], illustrate how individual energy services can be provided by a range of different renewable energy sources.

Table 2.2: Transitions to renewable energy in rural (off-grid) areas

Rural Energy Service	Existing Off-Grid Rural Energy Sources	Examples of New and Renewable Energy Sources
Lighting and other small electric needs (homes, schools, street lighting, telecom, hand tools, vaccine storage)	Candles, kerosene, batteries, central battery recharging by carting batteries to grid	• Hydropower (pico-scale, micro-scale, small-scale) • Biogas from household-scale digester • Small-scale biomass gasifier with gas engine • Village-scale mini-grids and solar/wind hybrid systems • Solar home systems
Communications (televisions, radios, cell phones)	Dry cell batteries, central battery recharging by carting batteries to grid	• Hydropower (pico-scale, micro-scale, small-scale) • Biogas from household-scale digester • Small-scale biomass gasifier with gas engine • Village-scale mini-grids and solar/wind hybrid systems • Solar home systems
Cooking (homes, commercial stoves and ovens)	Burning wood, dung, or straw in open fire at about 15 percent efficiency	• Improved cooking stoves (fuel wood, crop wastes) with efficiencies above 25 percent • Biogas from household-scale digester • Solar cookers
Heating and cooling (crop drying and other agricultural processing, hot water)	Mostly open fire from wood, dung, and straw	• Improved heating stoves • Biogas from small- and medium-scale digesters • Solar crop dryers • Solar water heaters • Ice making for food preservation • Fans from small grid renewable system
Process motive power (small industry)	Diesel engines and generators	• Small electricity grid systems from microhydro, gasifiers, direct combustion, and large biodigesters
Water pumping (agriculture and drinking water)	Diesel pumps and generators	• Mechanical wind pumps • Solar PV pumps • Small electricity grid systems from microhydro, gasifiers, direct combustion, and large biodigesters

Source: REN21 2010[16]

Many of the examples shown are proven technological options like solar crop dryers and water heaters, household and community biogas systems, mechanical pumps etc. Small-scale mini-grids based on renewable energy systems are in comparison a new and rapidly emerging area. There is relatively limited experience in the region with such systems where e.g. India has a number of programmes under implementation. Diesel mini grids are in comparison quite well established in most African countries and can evidently provide important learning in terms of experience with local grids. Similarly solar home systems have been implemented for a couple of decades in the region mostly as off-grid solutions, but

some experience is emerging on how a number of home systems can be linked together and provide learning on small mini-grids.

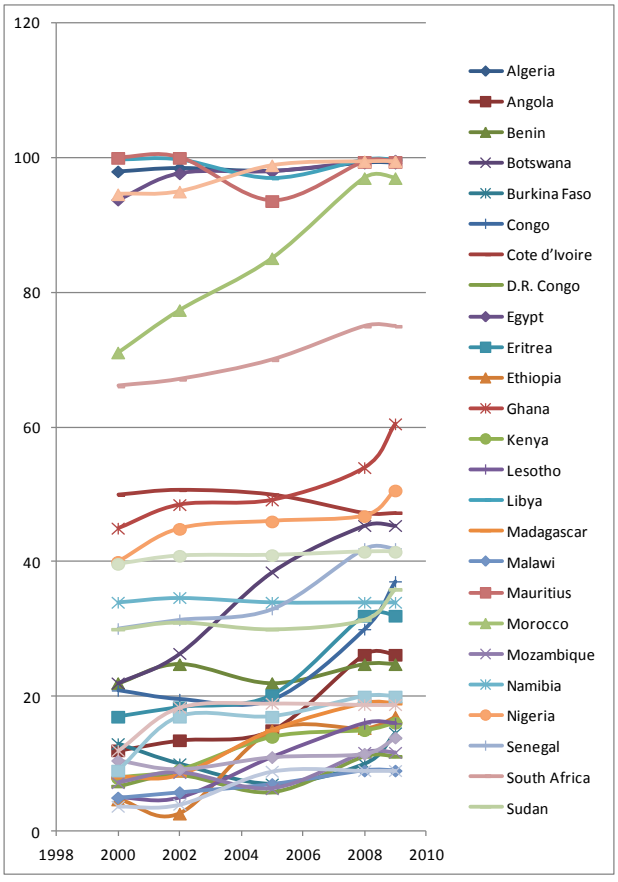
3 Electrification experience in African countries and lessons from other regions

Moving from the conceptual issues to focus on the core theme of electrification in the African region, the first section provides an analysis of the current situation and the very varied progress that has been achieved in different groups of countries within the region in recent decades. After that the detailed experience is presented from some of the countries that have made rapid progress with access programmes. This provides a background for the analysis in Chapter 4 which identifies key issues that countries must address, provided there is political will to expand electricity access significantly over the coming decades.

3.1 African electrification in recent decades

The 54 African countries exhibit a wide range of levels of electrification, from about 5% in some countries at the beginning of the last decade to essentially full access. Every country context is special and there are many reasons for the large differences in the level of electrification and the lack of action or rapid progress. Nevertheless, the attempt here is to identify and clarify some general patterns and tendencies, which can help us in specifying the necessary political, economic and institutional conditions and actions that are common for countries that have provided or are planning to engage in increasing access to electricity.

Figure 3.1 Electrification levels of 25 African countries 2000-2009

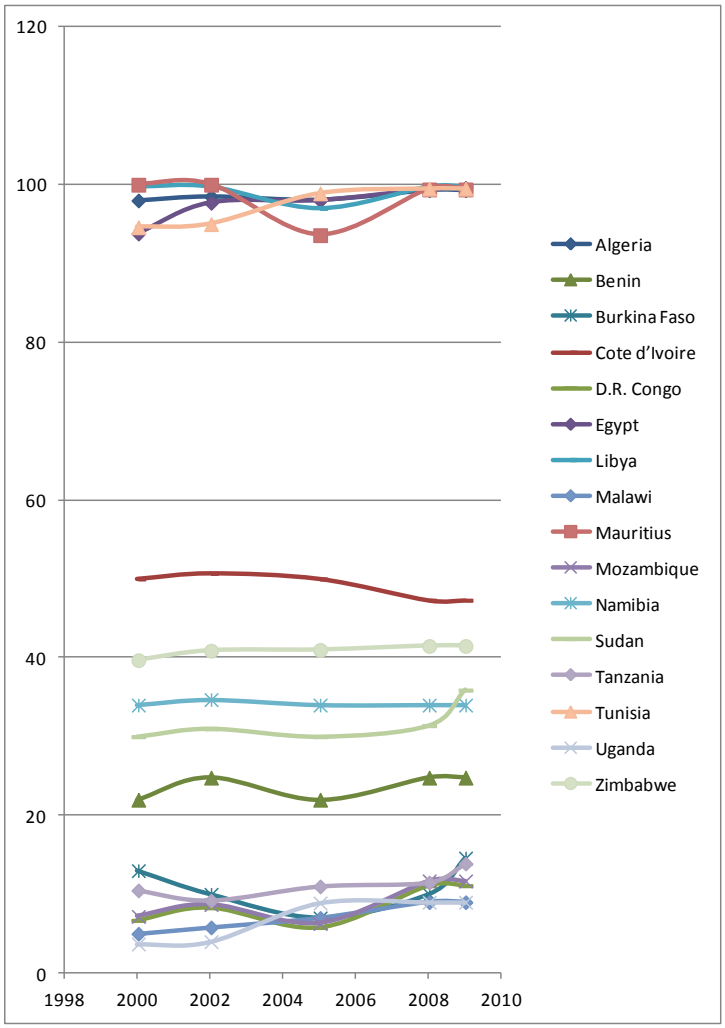


Source: IEA[17,18,19,20,21]

Figure 3.1 shows how the level of electrification in 25 African countries has developed since 2000, using available data from the IEA[17,18,19,20,21]. The graphics illustrate that countries can be group into three rather distinct groups: a number of countries with almost full access, a medium range group and a group with very low levels of access. In addition there is a small group of countries that have made distinct progress in the last decade standing out from the rest of the countries[22]. The three layered structure becomes even clearer with closer inspection in Figure 3.2 where the countries with significant increase in electrification have left out. Thus the initial analysis leads to a grouping in three categories and a fourth cross cutting group making distinct progress and this categorization and how it may help structure enhanced action programmes in the different types of countries will be further elaborated in Chapter 4.

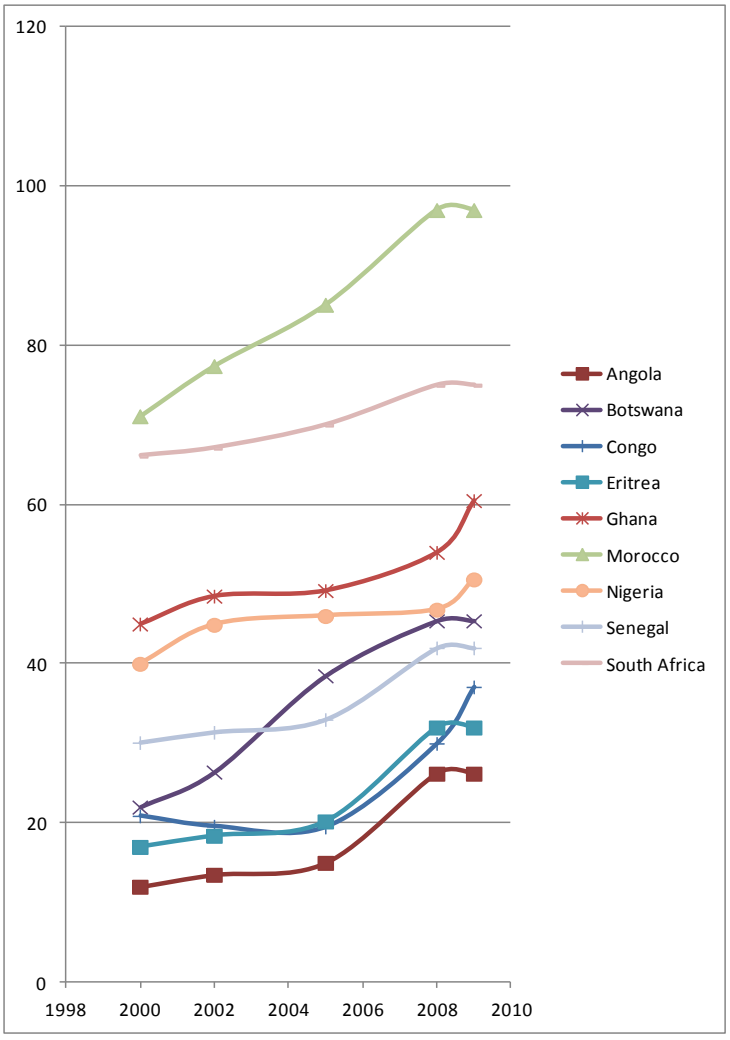
1. a high (90%-100%) electrification group, mainly North African countries, with a relatively constant level of electrification
2. a medium (20% – 40%) electrification group
3. a low (10% and below) electrification group
4. a few countries which have changed level significantly

Figure 3.2 Electrification level of 16 African countries with stable levels of electrification 2000-2009



Source: IEA [17,18,19,20,21]

Figure 3.3 Electrification level in 10 countries where the level of electrification has increased significantly between 2000 and 2009

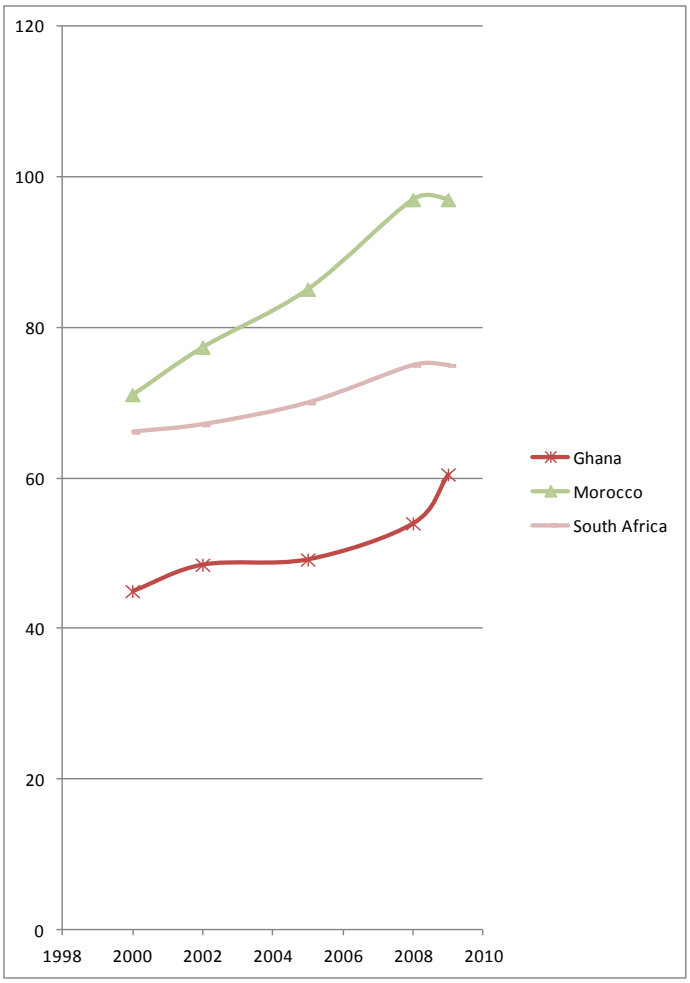


Source: IEA[17,18,19,20,21]

Figure 3.3 highlights the electrification development in 10 countries where there has been significant change. The reasons for these rapid changes in electrification levels need to be found at the national level, and in the next sections the experience from some of these countries is presented in more detail.

The essential observation at this point is that a few countries have managed to move away from a stagnant level of electrification and within a relatively short time span moved up to a higher level. In one case, Morocco, the transition has led to almost universal electricity access and Morocco has essentially joined the "club" of North African countries in the high access level group of countries.

Figure 3.4 Electrification level in 3 case study countries: Ghana, Morocco and South Africa



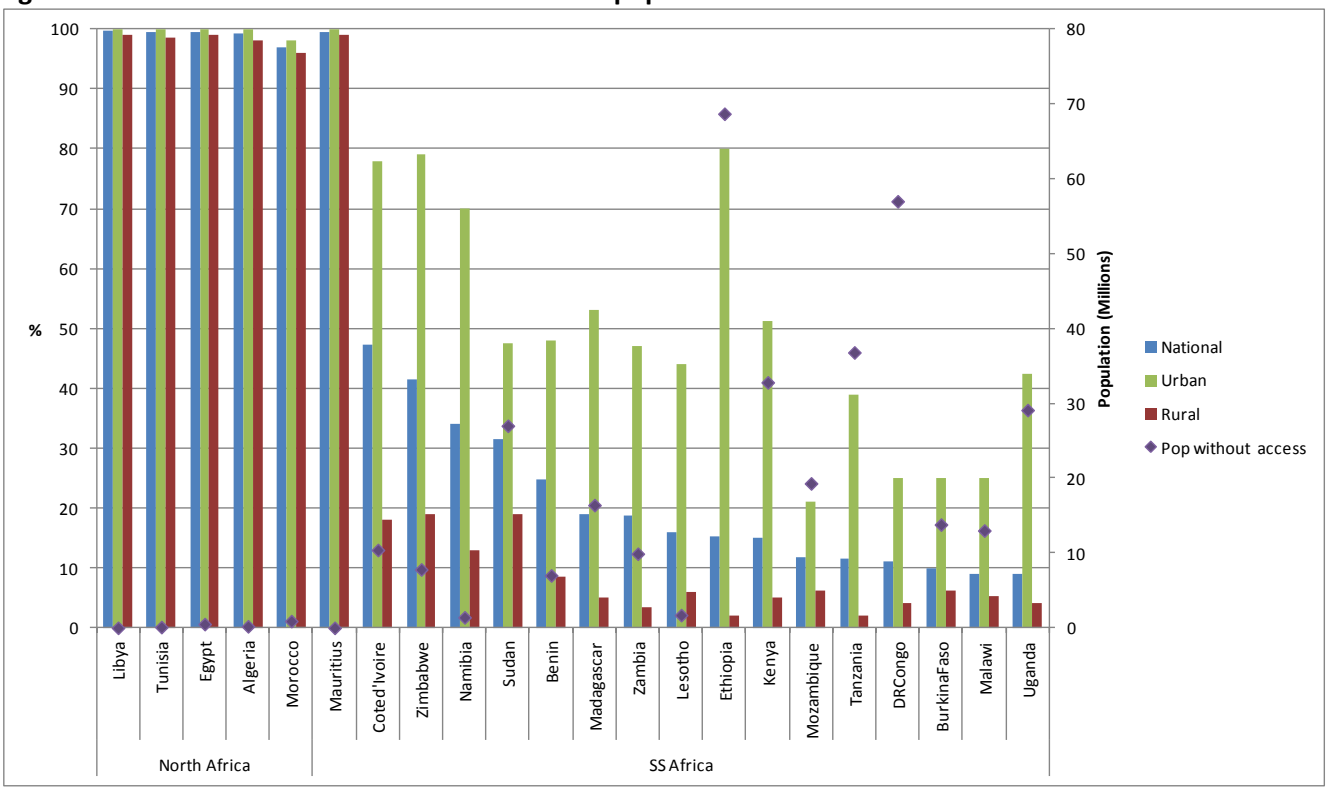
Source: IEA[17,18,19,20,21]

For South Africa, the time period covered in the graph does not fully convey the significant change in electrification level in that country which occurred essentially from the regime change in 1994. An extended graph back to 1990 would have made the significant change clearer. The three countries that have been studied in more detail are Ghana, South Africa and Morocco and their electrification development has been singled out in Fig. 3.4. Both the start and end points differ significantly and the same applies to some of the factors that have driven the processes, but as discussed in the cases there are some strong common features which can provide guidance for other countries wanting to embark on similar processes.

The factors that maintain the majority of Sub-Saharan African countries at medium to low levels of electrification are also country specific, but one common feature is that virtually all have extremely low level of electrification in rural areas. A recent World Bank study[23] found evidence of correlation between general urbanization patterns and the level of rural electrification, attributing the effects to the fact that many rural electrification programmes have used urban customers to provide part of the cross-

subsidizing for rural customers. This still requires more analysis and other aspects like general economic development is surely an important factor too. From Fig. 3.5 it is evident that without exception, urban electrification far exceeds the rural level in all countries, and in some case like Eritrea, Ethiopia, Tanzania and Uganda, the difference in percentage terms is an order of magnitude. Since these are all countries with relative low urbanization levels, the data support the hypothesis presented above and will be further discussed in Chapter 4.

Figure 3.5 Electrification levels for rural and urban population



Source IEA[17,18,19,20,21]

As mentioned above a number of case studies have been solicited for the preparation of this report. Regional and national experts have been contracted to examine the electrification experience and approaches in Ghana, Morocco and South Africa focusing on the following topics:

- What is the role of national and local public institutions in electrification, how can they be strengthened to enhance the electricity access process, and how should they relate to private sector and utility organizations?
- How can productive use (i.e. income generating activities) of electricity be increased in order to stimulate economic development and improve affordability of energy?
- Is it appropriate to use differentiated approaches for bringing electricity services to different target groups, for example low income groups where affordability is a major issue, remote consumers, and informal settlements?
- What should be the relationship between central grid expansion, local mini-grids and off-grid solutions? Can local systems be built in a transitional way and avoid being bypassed when the central system is expanded? Has this been attempted and was it successful?
- What additional challenges and/or benefits are linked to increasing the contribution of renewable energy supply? For example, what does it require, economically and technically, to convert current local diesel generation to renewable energy?
- What has been the role of international assistance agencies (bilateral and multilateral) in the process? How should this role be in future to further the process?

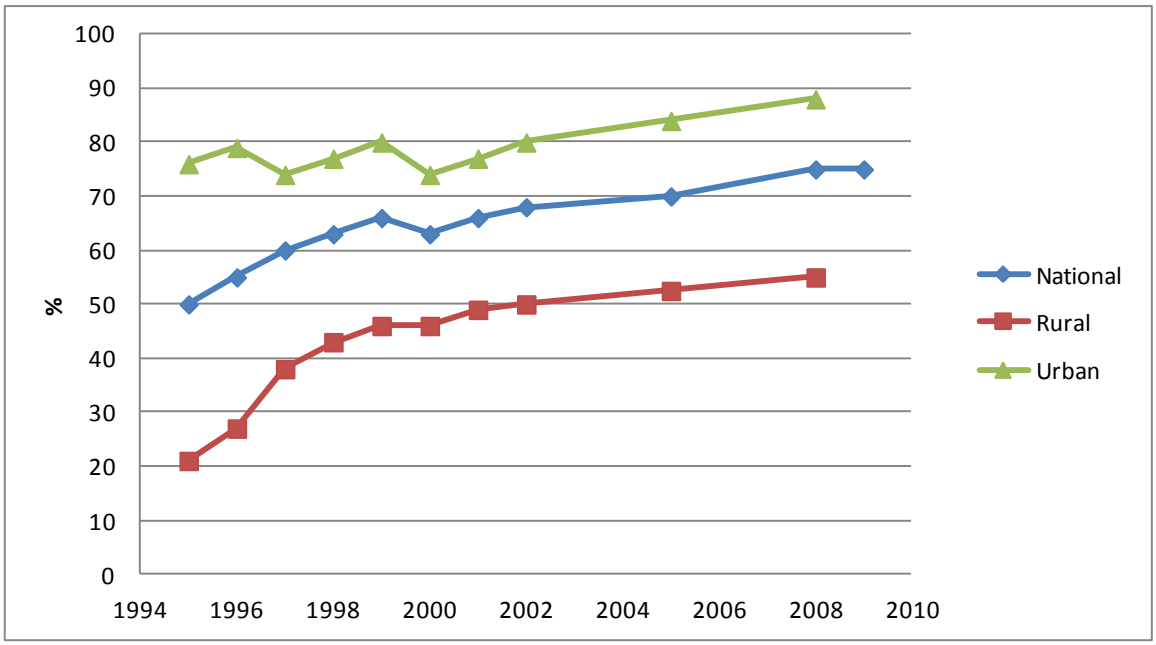
In addition to the country specific studies and additional broader regional study on the same topics was solicited from the Secretariat of the Club of National Agencies and Structures in charge of Rural Electrification (CLUB-ER), which includes agencies in charge of rural electrification from 25 African countries. The results of these studies are summarized in the next section and then in Section 3.3 complemented by some selected examples from other regions focusing on countries where the electrification process has “taken off” and countries with special experience with combining central grid expansion with dedicated focus on mini-grids. Finally the main conclusions are summarized in 3.5 before being used in Chapter 4 for the wider discussion on key issues for expanding access in the future.

3.2 Overview of case studies on electrification in Ghana, Morocco and South Africa

The three countries chosen for case studies represent three different but illustrative examples of how combinations of policies, funding and specific national circumstances have succeeded in increasing electricity access significantly, and especially providing services to the rural populations. First the general features of how the electrification levels have developed over the past two decades are described, followed by a discussion of the specific factors that led to the observed development in each case.

South Africa is a special case of rapid electrification where an aggressive programme following the transition to democracy in 1994 led to a rapid increase in the level of rural electricity access over just a few years, see Fig 3.6. The electrification in rural areas had since flattened out below 60% reflecting the fact that the remaining 40% of rural households was difficult to electrify due to a combination of difficult terrain, remoteness and poverty. The rapid increase in rural electrification was achieved through a combination of reasons, but the main driver was the political will of the new government and a concerted effort coordinated through the state-owned utility ESKOM, with primarily public funds.

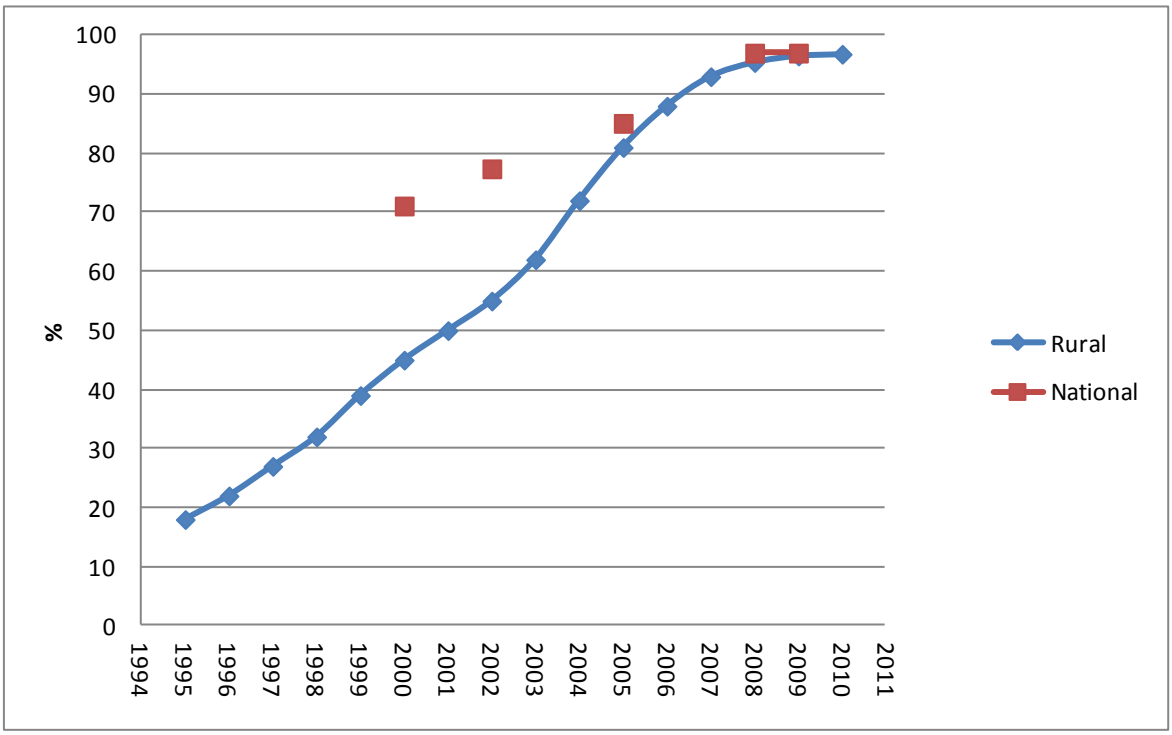
Figure 1.6 Development of electrification in South Africa from 1995 to 2009



Source: IEA[17,18,19,20,21] and Davidson & Mwakasonda[24]

In Morocco, where the access development is shown in Figure 3.7, a steady increase in electrification level occurred, from below 20% in 1995 to close to 99% by 2009. The level of urban electrification (not shown in Figure 3.7) was close to 100% throughout the period, and the approach to virtual saturation was therefore achieved almost entirely through electrifying the rural areas. Again, the drivers behind the rapid electrification were many, but the Moroccan case is one that largely confirms the hypothesis from the WB study[23] mentioned above that a high rate of rural electrification increase often correlates with a high level of urban connection, due to the fact that urban consumers helped subsidize the rural expansion process.

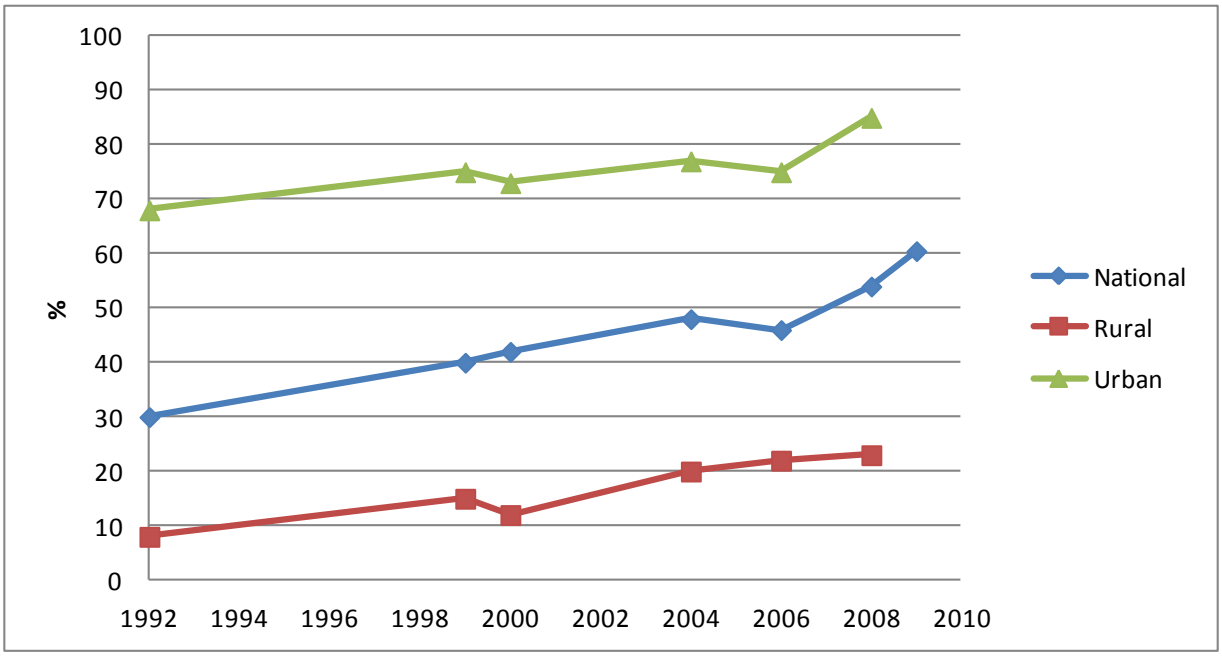
Figure 3.7 Electrification in Morocco, 1995 to 2010



Source: IEA[17,18,19,20,21] and Dafrallah[25]

The situation in the third case study country, Ghana, shows a situation more typical for the Sub-Saharan African countries, in which rural electrification was initially at a very low level (below 10% in 1992) and the urban level were moderate (68% in 1992). However significant progress has been achieved since then with a national electrification level of 60.5% in 2009, Ghana is the country in SSA with the third highest electrification level after Mauritius and South Africa (IEA data)[26]. There is still a big gap between the urban and rural areas (85% and 23% electrification, respectively, in 2008, IEA data) so there is still a huge challenge for the government to continue the success of its electrification programme into the more difficult sparsely populated rural areas. Nevertheless, compared to the typical electrification rates of 25% and less in the region at large, Ghana provides an important example for other countries and regions.

Figure 3.8 Electrification in Ghana, 1992-2009



Source IEA[17,18,19,20,21] and Kemausuor et al.[27]

3.3 Factors for success in South Africa, Morocco and Ghana

The case studies carried out for South Africa, Morocco and Ghana, together with the regional survey of experience in the Club ER countries, combined with a survey of recent literature point to a number of factors that contribute, or indeed may be essential, to successfully providing increasing access to electricity. It is these factors that can be critical in ensuring a transition from the low and medium level electrified countries to the higher levels.

The national experience and studies in the literature show that expanding urban electrification generally comes first, as could be expected, providing electricity to the high density areas and predominantly high income sections of the population is basically the logical approach from a business perspective. While this may not involve poorer peri-urban areas, it is predominantly rural populations that invariably lag behind, and the main challenge for countries even at medium levels of electrification is to bring power out to the dispersed and mainly poor communities in rural areas. These challenges have been met, or are being met in some of the countries in Africa, including the three case study countries, to varying degrees. The factors that have been identified to contribute to success are:

- Sustained government commitment
- Effective policies and institutions

- Sustainable financing
- Tariffs and subsidies
- Effective prioritization and planning and reliable data
- Reducing construction and maintenance cost
- Combination of grid and off grid options.
- Costumer focus, and linking electricity to local development
- Dedicated Local Champions
- Skills and Capacity

The following sections bring together the experience of each of the three countries with respect to these factors. Further details on the individual countries may be found in the case study summaries, presented in Appendices I, II and III.

3.3.1 South Africa

Sustained government commitment

Since the end of the apartheid era in 1994, there has been a strong political commitment to national electrification and financial support at all levels. In the National Electrification Programme (NEP) the first target was set for electrification of 2.5 million households by the year 2000, and 80% of households were to be electrified by 2012. In 2004 this target was changed to universal access to electricity by 2012. It is now accepted that this target is practically impossible by 2012 due to capacity and financial constraints, and a more realistic and achievable set of planning targets needs to be developed.

Effective policies and institutions

In 1994, Parliament approved The National Electrification Programme (NEP), as part of a National Reconstruction and Development Programme (RDP) to ensure equal access to basic services for all South Africans (later to be named Integrated National Electrification Programme (INEP) when established in the Department of Minerals and Energy on a permanent basis).

The National Electrification Forum (NELF), a broad-based stakeholder body with participants from Government, Eskom, municipalities, unions and others was established with the objective shape the electrification programme combining technical and financial capabilities with political legitimacy and support. The Forum formed an arena where stakeholders could negotiate the shape of the programme in a way that would be both politically acceptable and practically implementable[28].

An outcome of the NELF was establishment of National Electricity Regulator (NER), who was given the task to develop and oversee the implementation of the INEP until 2002.

During the period 1994–1999, the emphasis was almost solely on achieving the high connection rates outlined in the RDP, and creative ways were found to lower costs dramatically and overcome institutional barriers to achieve this. Due to the fact that rural areas were part of its licensed area of supply and had the largest backlog of electrification, the national utility Eskom took on the majority of the RDP targets (66% or 300,000 new connections per year), and local authorities assumed the rest.

Eskom was restructured early in the process freeing it from the previous prohibition on making a profit or a loss, and allowing the company more leeway in determining the viability threshold for electrification projects. These changes created a political opportunity for Eskom to establish itself as a national champion in the eyes of the new government. In 2001 Eskom adopted the same institutional structure as a private company with a board of directors (replacing the stakeholder-based electricity council) and a sole shareholder (the state via the department of public enterprises) and would henceforth pay tax.

In the late 1990s, electrification priorities shifted from primarily being on urban areas to becoming mainly a rural programme. In 1999 a fee-for-service concession based off-grid PV solar programme for remote rural areas was introduced to increase the speed of rural electrification. Six private consortia were engaged through an open bidding system to provide SHS and no fixed business model was required, leading to difference in approaches and eventually results.

A new policy of Free Basic Electricity (FBE) was introduced in 2004. This policy stipulates that the poor connected to the grid receive 50 kWh free of charge every month, which is sufficient for lighting, communication and very occasional basic cooking. This subsidy is paid directly to the service provider to minimize transaction costs.

Sustainable financing

The national power utility ESKOM had been operating the national electrification programme prior to 1994 primarily as a self-funding programme. This formed the basis for the initial activities, but realization that electrification of the poorer parts of the population could not be self-funded led to a second phase of programme financing, from 1995 to around 2000. During this period Eskom still played the lead role in financing the program, but underlying capital was accessed from various sources, including electrification bonds, or Electrification Participatory Notes, raised from private capital markets in the early days of the program, the returns on which were linked to consumption growth. Most funding, however, was in the form of a cross-subsidy from industrial users, bulk sales to municipalities, as well as many (relatively small) hidden cross-subsidies.

Corporatization of ESKOM in 2001 combined with the shift in emphasis of the electrification programme from urban to rural focus introducing higher average costs for connections meant that Eskom was not willing to continue funding the programme. This led from 2001 to the state funding electrification directly from the national budget.

Subsidies and affordable tariffs

The solar concession programme has been heavily subsidized. The recipients of solar home systems (SHS) paid an installation fee of about ZAR 120, a fraction of the actual cost, which was approximately ZAR 3500 for the system. The service provider subsequently owned the SHS and charged a fee of ZAR 58 per month for service and maintenance.

Effective payment recovery was achieved e.g. through smart cards which have been successfully used as an alternative form of metering and payment. Smart cards are pre-paid cards that the consumer inserts into a specialized meter for connection at the household level.

Effective prioritization and planning and reliable data

New and improved implementation processes played a crucial role, including greater use of decision-aiding techniques and tools, adoption of new financial evaluation methods (e.g. the modified Internal Rate of Return method used by Eskom), computer-based asset management, and software for feeder design. The decision by Eskom after 1995 to use a blanket electrification approach (i.e. provide supply to all potential customers in an area, also known as area coverage) instead of selective electrification (i.e. connect only the customers applying and paying for connections) allowed for long term rather than ad hoc planning, and removed cumbersome quoting and payment procedures[2828]. In addition, blanket electrification reduced perceptions of unfairness as everyone in the area receives access to electricity.

Reducing construction and maintenance cost

A number of measures have been introduced during the life of the program, including:

- Cost savings by changing traditional conservative design specifications to some more suited to the requirements of typical customers. This led to changes both in quality of supply and domestic load model specifications.
- Innovative technologies like prepayment electricity meters and the broader option of single phase lines significantly reduced both capital and ongoing costs per connection.
- Technology development played an essential role in reducing the real cost per connection (through innovations like Single Wire Earth Return (SWER) lines and leaner, more flexible design specifications) and reaching the social aims of the electrification programme (through innovations like prepayment metering and processes like blanket electrification).
- Strong research activity and knowledge sharing was a crucial component in the process of reducing transmission and construction costs[2828].

Combination of grid and off grid options

The PV SHS programme introduced above involves installation of photovoltaic systems in households too remote to be electrified through the existing initiatives.

The rural concessions scheme for solar home systems in South Africa represents one of the most ambitious projects of off-grid rural electrification using solar energy in Africa, along with the one described for Morocco.

Customer focus, and linking electricity to local development

Whereas during the RDP program, electrification projects, particularly those implemented by Eskom, occurred without reference to other local developments, under the INEP framework all implementers, including Eskom, were required to situate electrification projects within the applicable Integrated Development Plan, developed by local government. This process seems to have resulted in somewhat slower and less efficient implementation, but one which provides a more sustainable basis for long term sustainability, i.e. the programme shifted from a fairly narrow focus on connection targets to a broader set of development criteria[2828].

Dedicated Local Champions

In South Africa political support was the foundation, when the African National Congress came into Government the aim to provide power to the poor black communities was a major priority. The approach to implementation has changed a number of times, as describe, but the political ambition has remained the same. Three different groups of actors have played an essential role in the success of the electrification programme. Eskom was able early in the process to mobilise unique resources (managerial–technical skills, financial, economies of scale, and acted as a significant resource to central government in facilitating the development of organisational capacity within government itself. The second important group was local government. While this group was highly fragmented and faced many challenges, a few of the better managed municipal distributors made a significant contribution to the overall electrification effort. A third group, which was vital to the South African programme were the university-based electricity researchers who facilitated the political legitimacy of the programme essential to its sustainability and were the architects of the accelerated programme rural programme.

The ESKOM situation is unique to South Africa and cannot be directly replicated in other African countries, similarly independent policy research capacity on this scale is not often present, and was probably a unique ingredient of the transition.

Skills and Capacity

Research activity by a cohort of specialists prior to commencement of the NEP was crucial to the success of the electrification program, as was the ongoing development of skilled staff to implement the programme. Multi stakeholder knowledge sharing and transfer also occurred related to electrification, encouraged by a number of workshops and conferences[2828].

3.3.2 Morocco

Sustained government commitment

The Programme for Global Rural Electrification (PERG) was launched in 1996 as an ambitious national programme in which rural electrification was considered a key sector along with other important development areas such as rural road networks and rural water supply.

PERG moved Rural Electrification in Morocco away from fragmented donor driven initiatives towards a sequential programme approach characterized by long-term planning and financial commitment.

PERG embodied clear and time-bound targets: 90% rural electrification by 2010 with a total investment of Dh 15 billion (US$ 1.8 billion) and an annual average of 1000 villages (100 000 households) electrified. This objective was changed midway to a more ambitious target of 98% rural electrification by 2007, reflecting more rapid process than anticipated.

Effective policies and institutions

The PERG institutional approach is based on participative principles involving the utility as project owner and project manager, local municipalities as partners and co-funder, and the beneficiaries as co-funders and electricity users. Consultation committees were set up to discuss and validate the RE actions and follow up on implementation at local, regional and national levels.

The government established a legal framework to define the local operator's mission: whenever it costs more than Dh 27,000 (US$3,250) to connect a household to a grid, the house would be electrified using a photovoltaic kit. This helped the planning process by providing clear guidelines on when to pursue grid extensions and when to pursue the PV SHS option. Whether the threshold was gradually modified to reflect falling cost of SHS systems is not clear and if not it may have created a certain bias for grid connections over time.

There were basically two separate and distinct business models for centralized and decentralized electrification, respectively:

Centralized electrification:

The state-owned power utility (ONE) is responsible for the implementation of the National rural electrification programme. ONE is an integrated power company combing a national transmission and system operator, a distribution company (especially in rural areas) and a "single buyer" of electricity. ONE has a 50% market share in final power supply while municipal and private distribution companies supply the rest.

Under PERG a new structure was created within ONE to implement the PERG with a project management entity named Direction de l'Electrification Rurale with the necessary human capacity and technical equipment resources to complete its mission.

Decentralized electrification – PPP with a fee for service model

In June 2002, ONE entered into a public-private partnership (PPP) with the private energy service company TEMASOL to electrify rural households by using solar energy to produce electricity. The first phase was a ten year concession in which TEMASOL was committed to disseminate 16,000 PV SHS. In 2004 and 2007 ONE granted TEMASOL two new concession-contracts (2nd and 3rd phases) to disseminate 42500 PV SHS in 29 provinces throughout the country.

Morocco's decentralized rural electrification programme is based on a fee for service model to ensure the long-term success of the photovoltaic systems.

Sustainable financing

The PERG is financed by three partners: Local governments, beneficiary households and ONE.

For network electrification:

Local governments contribute 20 % of the investment. This is done with either Dh 2,085 per beneficiary household, payable in cash, or Dh 500 per year for 5 years. To this effect, they use equity, subsidies from the controlling department or development agencies, and loans from the Fonds d'Equipement Communal;

Beneficiary households contribute 25 % equal to Dh 2,500 which is either payable at the time of subscription, or with a fee of Dh 40 per month for 7 years;

ONE finances the balance and pre-finances investments. The cross subsidy contributes 35% of the investment (ONE draws a 2% levy on the on-grid sales) and uses concessional loans and equity for pre-financing.

In the subsequent PERGs, the ONE contribution increased from 21% (PERG1) to 65% (PERG 2-4), reflecting the focus on more distant and poorer communities.

For solar electrification:

Of the total cost of US$ 35.5 million for the first phase, an equipment grant from ONE covered sixty-six percent. The private operator contributed twenty-four percent of the project's cost. US$1.5 million came from self financing, while US$2.5 million was secured in the form of loans.

Monthly fees collected by the private company enable it to cover the amortization of its initial investment, replace equipment and cover running costs. Customers provide ten percent of the initial financing through connection fees. However, this cost to consumers is drastically reduced because of the government grant.

Subsidies and affordable tariffs

Rural solar customers receive a forty percent subsidy which makes the cost close to what city dwellers pay for the electricity they receive from the grid. These fees are affordable for a rural household that normally spends fifteen to twenty percent of its income on energy.

This three-way split of the financing together with cross subsidies, with grid-connected consumers paying a 2% levy on their monthly bill to help promote rural access to solar power, has helped ensure financial sustainability of the programme and financial robustness of ONE.

In total from 1996 to 2009, the total investment budget secured for the PERG amounted to over € 1,800 million annually. Over half (53%) of these resources come from equity; the financing complement, i.e. medium/long term concessional loans, was primarily contributed by the French Government (AFD), European Investment bank (EIB) and the World bank (WB).

Effective prioritization and planning and reliable data

A needs assessment was initiated at the start of the PERG throughout the country using a survey campaign that aimed at covering 40,000 villages. The utility technicians visited the villages to enquire on their geographical locations and boundaries, populations, number of households and businesses, their electricity needs, existing and necessary infrastructures, existing social amenities, etc. A database on the power distribution networks was also developed.

In order to manage the large amount of collected information on rural households and villages, economic, social and electricity infrastructures, the utility used a Geographical Information System (GIS). The GIS has been utilized for the RE planning and costing, the spatial positioning of the villages throughout the country as well as the evaluation of the PERG progress. During the conception of the programme the priority was given to the villages where households presented low electrification costs

(less than the limit fixed by the utility). The planning decisions have thus been based on the spatial optimization of the grid extension i.e. lowest cost for maximum village connections.

The main criterion of choosing the technical option based on the lowest cost of electrification was later complemented by a criterion of regional balanced coverage to insure all regions are equally benefiting from the PERG. It was decided to build medium voltage infrastructure networks, called « medium voltage backbones » in insufficiently electrified provinces and areas to open up areas where the electric network is underdeveloped and, by doing so, reach a better territorial distribution of electrification throughout the country. The financing of these backbones was fully ensured by ONE.

The various studies and pilot programmes operated by ONE prior to the large scale implementation of the solar programme was used to provide technical, social and economic data validation on concerns such as climatic conditions, needs of the rural population, purchasing power, and geographical distribution. This information assisted the Moroccan government in opting for the fee-for-service model, instead of the sale of equipment model that has been adopted in many other countries implementing rural solar electrification projects. The fee-for-service business model has in retrospect helped to make the project viable and sustainable.

Reducing construction and maintenance cost

Cost-efficiency principles were put in place under the PERG and included efficient design and construction for the grid extension. Special cost reductions actions included:

- Lowering the height of the Low Voltage (LV) poles from 10.5 to 9m then to 8m, which led to a reduction of 20% of the cost of the poles
- Placing the transformers at the top of poles, which permitted more than 35% cost reduction for transformer installation

Combination of grid and off grid options

Rural Electrification has been carried out through an integrated approach, including grid and off-grid options, under one single global programme PERG to ensure fairness in terms of advantages for the beneficiary and coherence in the Electrification. The large scale PPP on decentralised PV SHS running concurrently with the centralized programme is part of the reason why Morocco has achieved its high rural electrification rates.

It should be noted that SHS access not normally will provide the same level of electricity supply as a grid connection. As discussed in Chapter two this may not be a problem for small scale use like lighting and communication, but if household want more demanding applications like cooking the SHS cannot provide sufficient supply. Considering household types and income levels this may not be a problem now, but expected economic growth may lead to a need to reconsider the implementation model.

Customer focus, and linking electricity to local development

In order to be as close as possible to its customers, the private teams of the private contractor are present in each weekly souk (market) as the inhabitants of these regions regularly frequent them. This presence enables sales information to be given, contracts to be signed with new customers, monthly

fees to be collected and any repair requests to be logged. This local representation at the weekly souks and attention to customer support has resulted in a low payment default rate and helped the company develop a reputation for accessibility and trustworthiness throughout the communities.

The contractor used previously gathered social, economic and needs information to develop its marketing campaigns. Knowing that a large part of the target market for solar energy is illiterate, they produced a promotional audio cassette that was inserted as publicity material between songs on local radio broadcasts.

Local development and productive uses

Even though the ultimate objective of the PERG was promotion and facilitation of social and economic development as well as rural empowerment there has initially been limited consideration of the development dimension at the village/community level. It seems that at the launching of the PERG, there was no clear vision of how to undertake integrated local development.

A programme called Programme de Valorisation de l'Electrification Rurale (PVER) was subsequently put in place to focus on the development aspects and for example uses the infrastructure construction for rural electrification (150 000 KM of Low and medium voltage lines) as a lever for socio-economic development in the rural areas.

Institutional arrangements have been set up to implement the PVER with a dedicated office to elaborate and mange the programme. The regional/decentralized offices of the utility manage the programme at local level in collaboration with regional partners. Their main focus is to increase the number of clients with productive uses. The Utility partners for the PVER include: NGOs involved in rural development, micro-finance institutions, universities, financial institutions, local municipalities, international organizations, national and regional development agencies as well as the ministries in charge of Agriculture, Tourism, Handicrafts, etc.

Dedicated Local Champions

Similar to the situation in Ghana the government of Morocco has been providing the stable and long term political framework which has made the programme a success. Long-term planning has been implemented in a number of gradually adjusted steps providing a model for others to follow where local conditions make this possible. The long term political stability requirements for national funds to support the process will be a barrier for replication in many other countries, but long term international support may help overcome at least the last barrier.

Skills and Capacity

The necessary human capacity has been built at the utility company though the creation of dedicated office structures to implement and supervise the rural electrification programme. The regional offices of the utility have been mobilized to supervise the implementation of the programme at local level.

Installation and maintenance of the solar equipment could have been a costly venture for the private partner when comparing with experience from other programmes. But strong public support and the

decision to train and hire local technicians helped enable the company to provide prompt and reliable services to its customers, at affordable rates and thereby creating a viable business.

3.3.3 Ghana

Sustained government commitment

Successive governments have given high priority to improve access to energy services, with a strong emphasis on electricity and grid extension. In 1989 the National Electrification Scheme (NES) was introduced as the principal instrument to extend the grid to all parts of the country, setting the goal to reach all district capitals, and all towns and villages with more than 500 people by 2020.

Effective policies and institutions

The main policies in Ghana have been the National Electrification Programme (NEP) and the Self Help Electrification Programme (SHEP). Both policies were based on the National Electrification Planning Study which led to the National Electrification Master Plan - NEMP (1990-2020).

The first phase of NEP implemented between 1991- 1998 included electrification of all district capitals and towns, plus villages en-route to district capitals. The subsequent phases targeted communities in order of economic viability, based on a number of standardized criteria.

This strategy was adopted to ensure that the political administrative centres, which in most cases are also the commercial hubs of the districts, were covered first, enhancing economic activity and overall development of the districts. This had general acceptance politically, made economic sense and general social accept.

Electricity sector structural reforms, which have been quite extensive in many other African countries, have been moving slowly in Ghana and the electricity companies have continued to be government owned. Indications are that government is not convinced that structural reform and privatization are the best paths to performance improvements[29]. Meanwhile, access and quality of service are improving, suggesting that the government led utility model has its strengths.

In 1997 two new regulatory agencies were established, Public Utility Regulatory Commission of Ghana (PURC) and the Energy Commission. One important result of these new institutions was the restructuring of the electricity tariffs and introduction of a lifeline tariff by PURC. Together with introduction of a lifeline tariff, by PURC, came the publication of tariff-setting guidelines to improve the transparency of the tariffs[30].

The electrification model used in Ghana combines a utility and Public Private Partnership (PPP) approach. Utilities carry out network design and prepare the bill of quantities, while construction mainly is done by private contractors engaged by the Ministry of Energy (MoE) with supervision by consultants engaged by MoE. Commissioning is done with the utilities before they take over the network. In turnkey projects the utilities will have to approve the network design. The grid extensions are wholly done by the utilities. So quite strong central control combined with engagement of the private sector where it makes most sense.

The SHEP is a complementary activity to achieve the targets outlined in the master plan. Under the SHEP, communities that are within 20 km of a distribution network and that have initiated their township electrification projects receive government support for completion of their projects earlier than the scheduled date of connection under the NEMP. In this way the programme provides an incentive for local engagement to accelerate the pace of electrification.

The SHEP has been quite successful in connecting smaller communities, and was so popular that it had to be divided into several phases in order for the government to meet the demand. From 1990-2009 2837 towns have been connected through the SHEP. So while the programme has been highly successful with many households being connected, it has given little attention to smaller communities below the SHEP threshold criteria, resulting in smaller communities feeling left behind with no clear plans for connections.

Sustainable financing

The funding for the NEP came from came from a combination of domestic funds and international donors mainly in the form of grants and soft/concessionary loans.

As part of the NES, a National Electrification Levy/Fund (NEL/F) was established in 1989. The NEF is managed directly by the Ministry of Energy (MoE) and collects a one percent levy on electricity tariffs, charged on electricity consumption by all classes of consumers.

For SHEP the Government of Ghana has relied on grants and "tied" concessional mixed credit facilities to finance offshore materials and equipment for the projects. The loans are contracted by the GoG and are not passed on to the distribution utilities because the SHEP is considered a "government sponsored" programme. In addition to donor aid and direct government assistance, the NEF, has played a key role in supporting SHEP and other 30programmes[30]. Contributions from engaged local communities have also played a facilitative role.

Subsidies and affordable tariffs

The power sector reforms that have taken place in Ghana have been based on the rationalization of the tariffs in line with production costs and consumer interest protection. Access to the real and economic tariffs led to a progressive decline in direct subsidies given to electricity companies and cross-subsidies between the consumers. However, in order to minimise the impact of increased electricity prices to low-income consumers, the Public Utility Regulatory Commission of Ghana (PURC) – Electricity Regulator instituted a mechanism of "social tariff" to protect this group.

This tariff corresponded to 100 kWh/month level of consumption instituted in 1994 by the PURC. The tariff was revised in 1998 and was lowered to 50kWh/month, as it met the needs of the majority for electricity, and was within the budget of the low-income households in urban areas[31].

Effective prioritization and planning and reliable data

The original National Electrification Planning Study (NEPS), which was carried out by Acres International of Canada, established the foundation for the National Electrification Master Plan. The Master Plan

outlined an implementation plan made up of six 5-year phases spanning the 30 year period from 1990 to 2020.

While the electrification sites under the NEP had been pre-determined under the NEPS, selection of sites under the SHEP is undertaken by the District Assemblies. The District Assemblies communicate their decision to the MoE.

Reducing construction and maintenance cost

Cost reduction through the structured roll out of both the NEP and the SHEP has been a consistent focus of the programmes, but is hard to quantify. One specific example is a technology where the shield wires of the high voltage transmission lines are used as conductors, making access cheaper for communities along the transmission lines. It has been applied to serve 14 communities in the Brong Ahafo and Northern regions.

This approach has the potential to reduce the line costs for supplies to communities near the main line to about 10% of conventional costs. The constraint on the implementation of this technology is the risk of reducing the reliability of the transmission line and utilities in South Africa, for example, have discarded this approach. It is evidently only a relatively small portion of any country that can benefit from the approach because of the limited coverage of transmission lines.

Combination of grid and off grid options

Customer focus and linking electricity to local development has been part of the objective of SHEP. In addition strong engagement of local communities was seen as reducing overall cost for the government. Once the community contributes to the building of its local electricity network, it is also expected that the community will engage more in protection and guarding it against illegal use.

In the NEP Educational and health institutions have been among the first to be connected, and some communities have ridden on the back of these facilities to obtain access for the whole village[32]

It was not until the late 1990s that renewable energy sources (such as PV/SHS) were incorporated into the government's rural electrification plans. PV/SHS utilization was premised on the fact that it was virtually impossible to electrify certain islands on the Volta Lake and other remote areas through extending the national grid[3232]. However, the results of dissemination and installation of PV/SHS in the more remote rural areas has so far mainly been disappointing.

In 2009 the estimated number of installed PV systems was 4.601 which is very low when compared with South Africa and Kenya with around 150,000 and Zimbabwe with 85.000 installed systems.

The two major PV /SHS projects implemented in Ghana has been a Spanish funded off-grid solar PV rural electrification project in Wechiau in Wa West District initiated in 1998 and a GEF funded programme on a Renewable Energy Service Project (RESPRO) in Bunkpurugu/Yunyoo District, 1999-2004.

Overall the results have been less than satisfactory and policy and institutional failures have been attributed as the main barriers for successful up scaling of PV/SHS in Ghana. This includes lack of clear-cut policies on areas of PV/SHS deployment, not level policy measures for solar PV and the national grid,

absence of coherent provision for PV/SHS education and information dissemination, weak regulatory framework, lack of a dedicated national institution for deployment and promotion of solar PV and other RETs, lack of local/regional coordination, failure of leadership and absence of local plans[3232].

Dedicated Local Champions

Strong and consistent commitment from Government of Ghana is seen as a decisive factor in the rapid expansion of especially grid connected access. Access to power has become a major selling point for local politicians and the issues remains high on the both the national and local political agendas.

Skills and Capacity

The NEP promoted substantial institutional development and capacity building in the utilities engineering function through transfer of knowledge and expertise. Contracts under the NEP were implemented using local contractors in all the regions thus promoting the development of local capacity in distribution network construction[33]

3.4 Club ER countries

The Club ER is an organisation with members in 25 African countries, made up of agencies responsible for rural electrification. In October 2011 the countries represented were Benin, Burkina Faso, Burundi, Cameroon, Central Africa Republic, Congo, Côte d'Ivoire, Gabon, Guinea, Kenya, Madagascar, Malawi, Mali, Morocco, Mauritania, Mozambique, Niger, Democratic Republic of Congo, Rwanda, Senegal, Tanzania, Chad, Togo, Tunisia and Uganda.

The broad experience of these agencies over the past decade has been captured in the fourth case study, which brings together in depth analysis and accumulation of experience and recommendations from the 25 countries with regard to a number of key aspects of electrification. The findings focus on institutional and financial issues, so is not directly comparable with the national experience analysed above, but the finding are considered to have broad relevance most countries in the region and therefore complement the national finding from Ghana, Morocco and South Africa.

In general the study identifies two broad electrification models that have been used in member countries:

A historically dominant but now **"minority" model**: Reflecting countries where the national electricity company has been maintained as the central entity for rural electrification. (e.g. Tunisia, Morocco). This model is characterized by:

- Reinforcement of the social role of the national operator who maintains a monopoly position in the electricity sector;
- In some cases, the absence of a regulation entity, agency, or rural electrification fund;
- Rural electrification investments initiated with equity;

- Operator has leveraged funds with government guarantee. Opening of the rural electrification market to the private sector.

A **"dominant" model** reflecting the situation in countries where major reforms of the electricity sector has taken place and utilities no longer could support the financial burden of a rural electrification programme. (e.g. Burkina Faso, Kenya, Madagascar, Mauritania, Senegal, Tanzania, Uganda) This model is characterized by:

- Liberalization and opening to the private sector with or without privatization of the national company;
- Structure fragmentation on the institutional side, often with a regulation entity, rural electrification development agencies or rural electrification funds;

The study shows that those CLUB-ER countries that have developed institutions in line with the dominant model generally face challenges in their ambitions to increase access to modern energy services, some of these challenges include:

- Weak legal and institutional frameworks with difficulty in attracting private operators, in particular international.
- Weak domestic financial institutions; high up-front cost of renewable energy technology; inadequate financial incentives to attract the private sector; weak channelling of finance from international sources in the rural electrification context characterized by the unprofitability of the investments (low demand, low income)
- Poor functioning institutional structures (REA, REF etc.)
- Insufficient political will to set clear plans and strategies in coordination with other key sectors.

These challenges mirror to a great extent the factors that was identified in the previous section as key to success in the three case study countries (Table 3.1), and the implications will be further discussed in Chapter 4 when identifying the key issues to be addressed for successful access programmes.

Table 3.1 Correspondence between challenges in Club ER countries implementing "model 2" and the success factors identified for case study countries.

	Weak legal and institutional frameworks	Weak domestic financial institutions	Poorly functioning institutional structures	Insufficient political will to set clear plans and strategies in coordination with other key sectors.
Sustained government commitment				
Effective policies and institutions				
Sustainable financing				
Effective prioritization and planning and reliable data				
Reducing construction and maintenance cost				
Combination of grid and off grid options.				
Costumer focus, and linking electricity to local development				
Dedicated Local Champions				
Skills and Capacity				

The following are recommendations for countries that follow the dominant model to achieve their goal of broader access to modern energy in rural areas based on Club ER members' experience:

Institutional framework

- There is a need for a clear vision/strategy at the national scale and with a specific time horizon, describing the role of public authorities at all levels (central government, local authorities, rural agency institutions, etc.). The history of successful rural electrification programmes also shows the importance of incentives for local entities, communities, and private companies to engage in rural electrification projects.

Regulatory framework

- There is a need for transparent regulatory and fiscal frameworks and incentives for the private sector; particularly, regulation mechanisms adapted to rural electrification specificities. This includes simplified authorizations and transparent contractual terms for PPPs, lighter standards, prices that match payment capacities while guaranteeing acceptable profits for the operator, etc.
- Cost reduction at all levels, including regarding standards, should be one of the main concerns for rural electrification. In this area, innovation should be a main focus of the programmes.
- Special attention should be given to the creation of a regulatory framework able to boost the use of renewable energy sources and technologies: Feed-in tariffs to sell electricity to the grid, power purchase agreements (PPAs) adapted to renewable energy promoting this type of investments.

Financial framework

- There is a need for appropriate public instruments and resources to ensure the financing of part of the electrification investments and the need for necessary guidance during the operational phase.
- Assessment and update of current financing instruments and schemes: RE funds should be able to mobilize available resources to finance national RE programmes; thus they will have to find new refinancing partners. To do so, they must improve and become full-fledged financial institutions. Therefore they need not only adequate project accounting capabilities, but also fully operational financial engineering for optimal capital mobilization;
- Attractive electrification programme presentations, based on a rigorous, up-to-date, designed to convince financial decision-makers business plan. Funds should clearly be separated between the development function and the financing function.
- In order for rural electrification entities to be credible partners of international financing institutions and be refinanced by funds of funds, new generation funds should rely on a solid financial foundation. This will require a reassessment of the following:
    - The project portfolio: Rural Electrification Funds should be able to present a planned project portfolio with different risk/reward profiles. They should be able to finance not only unprofitable operations in some rural areas, but also profitable plants in larger rural communities or even decentralized green energy plants;
    - The ownership of governmental investments (assets): Concession contracts are often vague on this important question: Who owns what, during the concession period as well as at the termination of this period? It would be wise to structurally reinforce the current funds and allow them to become owners of the plants with assets on their balance sheet;
    - The opportunity for a rural electrification fund to be included in the operator's assets, temporarily or for a definite term, if that facilitates the securing of financial flow;
    - The opportunity for rural electrification funds to legally contract loans and act as guarantor, either directly through its by-laws or through an "agent" selected by means of invitations to tender, or through the national bank;
    - The opportunity for funds to benefit from government guarantees to have access to institutional donors.

Technical aspects

- Need for technical assistance services to boost the sector and the emergence of effective capacities within national SMEs.

Efforts to improve financial and institutional efforts should not prevent a continuous attention to the technical aspects in the rural electrification. The experience of CLUB-ER shows that the key to achieving greater coverage in a context of scarcity of financial resources is the complementarity of approaches including grid extension, decentralized electrification and cost reduction within existing grids.

- Main recommendations is that the electrification actors should be equipped with and trained in the use of vital cost reduction tools, which are both versatile and value for money,

for the planning of power systems and electrical and mechanical calculations concerning both central and local mini-grids[34].

Regarding the strengthening of multi-sectoral coordination to encourage **productive use of energy**:

- Opt for internal establishment of national multi-sectoral groups and strengthen their political and institutional grounding at a national level;
- Strengthen in particular the participation of national multi-sectoral groups in the various processes to develop sectoral strategies, plans and programmes, especially in the sub-sector of rural electrification;
- Ensure that multi-sectoral strategies, plans and programmes are consistent with the strategies, plans and programmes aiming for universal access to energy services for a given area or timescale; rather than initiatives which are isolated or carried out in parallel with rural development initiatives, this involves optimizing efforts, using resources rationally and guaranteeing the implementation of multi-sectoral programmes, including at a funding level;
- Ensure future operational funding for multi-sectoral coordination by incorporating it into the governmental budget;
- Share multi-sectoral data, particularly using remote exchange platforms based on Geographical Information Systems (GIS) and internet technology, as a means of firmly establishing mutually beneficial and long-term multi-sectoral coordination between institutions.

Finally, the objectives of increasing access to modern energy through the recommendations mentioned above, can be achieved only with the strong political will and involvement of the public authorities. Governments should have prominent role setting clear plans and strategies, also in coordination with other key sectors, in coordination and for boosting investments in the electricity sector, and particularly in the rural electrification sub-sector, as well as maintaining services at prices affordable to the largest number of consumers. The strong political will must be supported by the continuous effort of the international communities.

These detailed findings and recommendation together with the national experience and an extensive literature review for the basis for the analysis, conclusions and recommendation made in the next chapters.

In order to complement the African experience where both South Africa and Morocco in different ways present somewhat unique settings, a review of experience from Vietnam has been included for comparison and learning. Vietnam has also expanded access rapidly in the last decades.

3.5 Vietnam

Sustained Government Commitment

The national utility, Vietnam Electricity (EVN), estimates that in 1975, electrification among poor households in the country was no more than 2.5% and little over 3 decades, Viet Nam has been able to

connect millions to the national grid. By 2009 the country had electrified 96% of its households, bringing modern power to the Vietnamese people in both urban and rural areas[35].

The Electrification programme has been Government led, and there has been a strong continuous commitment to rural electrification since the mid-eighties with clear goals and targets and adoption of a long-term national plan. Viet Nam had from the outset a priority system for rural electrification focusing on expanding economic development so irrigation systems were the first priority and small rural industries came second. These priorities ensured that it was not only in the major cities electrification expanded, but really countrywide with a focus on economic development at the local level. Households were not a priority and this lead to districts with good access to electricity but few households benefitting.

The establishment of Vietnam Electricity in 1995, coupled with the resulting reforms in the power sector for the basis for s shift in focus with increased attention to rural household electrification. Electrification levels subsequently have increased less than 50% in the late 1980s–early 1990s to 77% by 2001 and 96% by 2009. It may be argued that the first phase focus has created part of the economic foundation for the second phase expansion, but with other priorities it may have been possible to do it in parallel.

Table 3.2 Overview of funding sources for Vietnam's rural electrification program

Sources	To	Purpose	Mode and Terms
Central Government	EVN	Major projects and some intervention in the operation of EVN	Replenishes EVN's working capital and offers a minor contribution to investment (around $10 million per year in 1999); Extends loans at a preferential rate of 9.7% (1999); and Can also guarantee EVN's loans and bonds.
EVN or Power Company (Distribution)		Construction of high and medium voltage lines, distribution substations, and household meters	Funds are sourced from EVN's income from tariffs; Accepts funding from government and donors; and Can issue international bonds and use own depreciation funds.
Provincial Government	Power company or local authorities	Contribution to medium voltage lines (through power company) and low-voltage lines, done in cooperation with local authorities	Uses taxes in contribution from local authorities.
Local Authorities (District, Communes)		Set up low-voltage networks, including clearing and ensuring right-of-way for lines	Uses local taxes and/or district contribution to communes and/ or user fees. Local authorities can also take out a commercial loan.
Residential Consumers		Local networks, household connections	Uses own finance or own labour at own or community's risk.
Private		Particular projects	Mostly interested in generation projects; Offer private funding terms.
Banks	Extend credit to local authorities and households		Commercial terms but not covered by EVN.
Donor Agencies	EVN or power company; credit schemes for consumers; increasingly working through provincial and local authorities but province cannot be direct borrower	Generation, transmission, distribution, rural electrification	Project by project or program; Offers a low interest rate for rural electrification (less than 7%).

Source: ADB 2011[3535]

Effective Policies and Institutions

The electrification programme has included both a top-down approach led by EVN and its subsidiaries, complemented by a bottom-up approach that has attracted broad and active participation of communes and individuals at the local level. Through a set of laws and policies the government has equipped EVN with the mandate and resources needed to take the lead in rural electrification in a financially

sustainable way. Division of responsibilities between utilities and local communities has been part of the success along with broad participation of local governments and communes in planning and cost sharing.

Sustainable Financing

The Central government has on an ongoing basis committed long term funds to the programme from the state budget. Even in times where the central budget has been scarce, the limited funds available were reserved for the electrification.

The presence of cost sharing among different parties has been an important contributor to the success of the programme. The cost sharing system involves the EVN's Power Corporations (PC) financing MV and LV systems, while provinces covered the cost of land acquisition and compensation, and customers paid for service drop to their households.

An overview of the financing structures for the programme is provided in a recent report by the Asian Development Bank[3535] where the electrification experience of Vietnam is also presented as success story for other countries to learn from.

Effective Prioritisation and planning and reliable data

Early development of the national hydropower potential combined with focus on establishing a national grid system with the construction of a 500 kV transmission line running the length of the country in 1986-93 (which would also serve as a unifying force) laid the technical foundations for significant progress in rural electrification in the subsequent periods.

Reducing construction cost and maintenance cost

The establishment and enforcement of technical standards for rural systems has been an important factor with technical specifications and standards for rural electricity systems in Vietnam being developed and operationalized in the period between 1998 and 2004.

Outsourcing of commercial and maintenance services in rural low-voltage systems using a service agent model where local community members maintained systems, carried out simple repairs, and handled revenue collection. This helped ensure accountability within local communities, minimize non-payment, reduce system losses, and significantly lower the costs of system operation and management for the PCs.

Combination of grid and off grid options

While most of the electrification has taken place through central grid expansion, many of Viet Nam's communes in the early stage of the programme developed mini-grid systems to supply their own isolated communities. Mini grid systems are generally simple, and easy to operate and maintain, plus involved local communities in construction. Over time the national grid expansion has reached many of these communities and the local supply has subsequently been connected to the grid or taken out of operation depending on size and efficiency.

A number of communities still depend on local systems and in 2009 around 56,000 households still depend on local systems. The latest survey of the Institute of Energy identifies 169 off-grid systems in operation with a total capacity of 132 megawatts. Most are located in the North Mountain Region.

Almost all systems are powered by some form of renewable energy resource with biomass and mini hydro being the dominant ones.

Dedicated Local Champions

Strong and stable political commitment to expanding electrification has, as in the African examples, been instrumental as the foundation for the successful programme.

The effective leadership of a strong utility (EVN) responsible for planning and implementation even of medium-voltage and low-voltage projects in rural areas has been instrumental, ENV has also provided technical assistance to the weaker local utilities for them to play a strong role in implementation and running of the systems.

Effective partnership between EVN and local authorities, and communities has also been an important factor.

Skills and Capacity

EVN helped build local utility and community capacity by providing training to local community groups and assisting local authorities in system planning and design.

Also, the local power corporations provided training to a large number of local people, who then became "service agents" responsible for routine technical and commercial operations and maintenance, such as meter reading, billing, collections, monitoring of rights-of-way, and minor repair of in-house wiring.

Common elements of experience

All countries have their own unique experience and the development of electrification in Vietnam reflects a number of specific political, institutional, cultural and natural conditions. But the Vietnamese story also has a number of common features with the success stories from the African region presented earlier. Strong and sustained political commitment to a national electrification programme combined with an empowered central institution to oversee the planning and implementation of the programme. Strong elements of capacity building at all levels have been included and extensive engagement of local communities in the planning and in many cases also implementation of the plans plus operation of the installed systems. In addition programmes have been updated and revised as experience was gained and underlying technical and market conditions changed.

The experience includes a number of mistakes and failures on the way, which have not been highlighted here but the learning they represent underpins the conclusions.

This experience will be elaborated in the next chapter into a set of key issues and recommendations with the aim of providing guidance for countries in Africa wanting to expand electrification programmes.

4 Key Issues for national electrification programmes emerging from experience

The presentation and discussion of key issues in this section focuses on the national perspective. The aim is to contribute to a better understanding of both the basic conditions for successful electrification programmes and the approaches that have proven effective in countries that have succeeded in rapid expansion of access. It has been emphasized throughout the paper that all programmes need to be country specific and adapted to the local conditions in every sense of the word, but the case examples provide significant evidence that national programme design can benefit from and build on.

The case examples do not cover all aspects. For example central power capacity and grid structures have not been addressed in detail. Nevertheless both the South African and Vietnamese cases make strong reference to the importance of significant initial power capacity and central grid structures in the choice of expansion model to be adopted. Similarly, financing is not addressed in detail in all cases.

In addition to the information from the case studies the following sections therefore draw upon some recent studies of electrification programmes in Africa and other regions by the World Bank and International Energy Agency[2323,36,37,38] experience

4.1 Political commitment

One of the clearest conclusions of all the case studies and the mentioned literature studies is that ***strong and sustained government support*** is the single most important pre-condition for a successful access programme. In most cases this means long-term commitment by both central and local governments over a 15 to 20 year timescale, as the framework for the more detailed institutional, technical and financial aspects.

Political commitment has to be combined with effective policies and institutional approaches for programmes to become successful. Political will is therefore an absolutely necessary pre-condition for success, but not sufficient. It must be accompanied by well designed policies and implementation approaches.

Government commitment to enhanced energy access will require incorporation of these priorities into national development and poverty reduction strategies, plus, as discussed further in Section 4.3, elaboration into detailed policies and plans.

How government support emerges or can best be established may merit a study in its own right, but the best driver would be strong local interest reflected in local election agendas. Strong engagement of local communities is in any case an important factor for successful programmes. International agreements and target setting, as discussed in connection with the Rio+20 Summit, is a completely different way of generating more top-down political commitment. However, as noted earlier in connection with the current national renewable energy targets in the African region, such internationally established goals often remain political aspirations, unless it is documented that they clearly support and can be integrated in local development. The emphasis introduced in Chapter 2 on combining electricity access

programmes with a strong focus on productive uses and employment generation to stimulate local economic development is therefore likely to provide stronger political motivating factors than a globally agreed target on its own.

4.2 Institutional issues - role of national or local institutions in electrification

The case studies all point to the importance of having a strong central institution in charge of the overall electrification programme, either in the form of a government agency, a utility or a dedicated independent institution. The World Bank studies that have taken a broader look at other countries in the region note that there is no evidence of one clearly superior organizational model, but in almost all cases a clear institutional framework is a prerequisite for success.

With power reforms in many African countries over the last two decades most of the earlier state-owned utilities have been privatized and independent regulatory bodies established to oversee the power market. The results of the reform programmes still need to be fully evaluated with regard to how they have delivered on the key drivers for reforms, which were often inefficiency of the former utilities in terms of cost-effective delivery, maintenance, attraction of foreign capital for expansion, etc.

The study by Eberhard et al.[2323]. records very mixed results with reforms in the region, and notes that, after a first round of private management of utilities, many countries have reverted to some form of state led operation, maybe in a hybrid fashion with a degree of private engagement. The report also notes that power markets in many African countries may basically be too small to provide a sustained basis for a number of power generators and in this way questioning one of the underlying premises for reform. However, a country like Kenya has experienced some success in introducing both part-private ownership of the national utility and recently allowing private power producers to sell to the grid. As noted before, the specific national circumstances need to be understood before more general conclusions on reforms can be made.

When examining what reforms have done to expand access for the urban and rural poor, the answer is more clearly negative[3] Access expansion has often been a secondary objective of reform efforts and has therefore been left for later action, after the central structures have been established. Many countries have then subsequently established what in Section 3.4 was termed the “dominant model” by the Club ER where responsibility for electrification expansion was left with relatively weak Rural Electrification Agencies (REA) often combined with a dedicated Rural Electrification Fund (REF). The study by Mostert[37] has specifically examined the experience with REAs and REFs in the African region, and the conclusion is quite clear. “Ring-fenced” funds for electrification programmes are necessary for consistent long term implementation; the earlier quoted GNESD study also confirms this finding. The studies are less conclusive on the need for a dedicated REF and on whether the “ring-fencing” can be achieved by other institutional means.

On analysis of REA experience, the conclusion by Mostert is very clear and supports the findings from the case studies that a central institution or utility is likely to be more effective as the responsible agency for a national electrification programme while institutions like REAs may play a very useful role in relation to the management and implementation of the mini-grid and off-grid parts of an integrated

electrification plan. There may be examples where this broad-based conclusion is not fully applicable, as it is impossible to isolate institutional issues from other factors like political commitment and domestic finance availability. These factors may have been strong contributors to the lack of success for REAs in some of the countries analyzed, but as general guidance for new national programmes the conclusions seem quite robust.

How the responsibilities of the central entity are designed and delineated will depend on the existing national institutional conditions and the tasks to be performed. This will be further discussed in relation to policy, strategy and implementation in the next section.

4.3 Policy and strategy development and implementation

On the policy and strategy development aspects the case study conclusions are again quite uniform. The supporting studies by WB[23,36] and IEA[37,38] generally confirm this and can be summarized below:

A nationally integrated electrification and development plan covering a span of several decades needs to be developed as a basis for prioritization of actions. It should examine both central grid expansion, establishment of local mini-grids and off grid solutions based on careful study of the existing population distribution, current energy and electricity consumption and projections over the relevant planning period.

The responsibility for development of the plan should be directly with government or with the type of centrally responsible institution described above. Reflecting the discussions of the need for an “energy plus” and service-oriented approach in Chapter 2, it is emphasized that the plan should not only address electrification, but also local development plans. This means that close collaboration with relevant ministries and local authorities will be required to facilitate the desired economic development benefits from electrification.

Very few countries in the region would today be able to replicate the Moroccan experience which was based largely on public finance with a strong utility responsible for the initial programme implementation. National action therefore has to be prioritized as part of the plan, and to ensure public acceptance, the criteria for this prioritization need to be clear and transparent, and made public. Prioritization may, like in the Ghanaian example, involve incentives for local communities to engage actively in planning and financing where participation and co-finance can help accelerate programmes for the local community. This evidently needs to be balanced, so that it does not leave the poorest of the poor at the end of the line with no option to move up.

For many countries, the choice between grid expansion and local off-grid solutions will depend on a large number of factors.

- Traditional power sector planning including electrification programmes has focused on least-cost approaches, but often interpreted in a very narrow sense and with little consideration of development effects, employment aspects or even capacity requirements for the grid system. Eberhard et al.[23] note that power supply, especially in Sub-Saharan Africa, is notoriously

unreliable and capacity expansion has been lagging behind demand leading to extensive power outages in large part of the grid connected system in many countries. So even if access programmes do not require large scale capacity, they may both risk straining already under capacitated central systems, and lead to a situation where physical access to the grid cannot deliver the expected services. This situation was described in section 2.1 where the IEA analysis showed that this leads to productive losses, parallel independent generation and reduces the incentive for poorer households to pay for connection and equipment.

- New mini-grids and stand alone systems are obviously not affected by deficiencies in the central system, but there are some important differences in what kind of services the different options provide. Stand-alone systems like PV solar can deliver an important basic supply of electricity to remote communities and households, but it is not economically feasible at present to use this technology for providing for services beyond lighting, ICTs and low-power equipment like sewing machines and small refrigerators. The social benefits from lighting and communication are, as described in section 2.1, still very valuable, but do not form the foundation for self-sustained economic development. Local mini-grids are well established in many countries, mainly powered by diesel generators and generally accepted by the served communities. An important feature of mini-grids is that they can generally provide a full range of electricity services and three-phase electricity, which is powerful enough for productive and community needs, such as water pumping, machinery, grinding, welding, street lights. Another benefit seen from the integrated national programme point of view is that mini-grids can operate with the same voltage and frequency as the bigger national grid, meaning that the same appliances and wiring can be used if or when the community is connected to the national grid. Local mini grids are increasingly being powered by a range of local renewable energy resources (solar, wind, biomass, hydro etc.), reflecting both the rapid increase in diesel prices and increased competitiveness and reliability of many renewable energy technologies. It may also be possible to build mini-grids based on previously installed stand-alone systems, such as PVs. Mini-grids have in this way flexibility to support gradually increased demand by incrementally connecting additional renewable energy capacity. In the short to medium term, mini-grids could become important drivers for technical innovation and expansion in renewable energy electrification, e.g. through smart grid approaches, more efficient inverters and remote monitoring systems.

The national electrification plan will need to take all these aspects into account and develop technological solutions for the different parts of the country from peri-urban settlements to townships and all the way to the more remote rural villages. The main point from the discussion above and from the national case examples is that grid extension and off-grid solutions need to be considered in an integrated manner and may very well be implemented in different parts of the country in parallel.

As already discussed, it will be important for the success of the programme to engage the local communities in the decisions on how best to provide electricity in the short and long term. The criteria for making choices also need to be clear and well communicated. The ultimate goal for most countries is assumed to be an integrated national grid system, and other (decentralised) solutions

for some communities may be regarded as second best. However, if the choice is between a local solution now, with a clear plan for a gradual transition towards later grid connection, and a long wait for any form of electricity supply, most communities would opt for the gradual build up, especially if it can be combined with strong local engagement in planning and implementation.

Over recent decades most countries in the region have been engaged with external donors in a series of pilot programmes bringing home systems or local grid systems to rural communities. Many of these programmes have resulted in significant benefit, but the lack of an integrated national planning framework has often left communities with limited capacity and no clear plan for how to expand or even sustain supply. This broad statement evidently does not do justice to the many well designed and well functioning programmes that have also been implemented, but the point is that *if the political ambition is to make major improvements in electricity access in Sub-Saharan Africa there is a need to move from fragmented programmes and pilot projects towards integrated action at national scale.*

At the same time it will be conducive for success if the often fragmented debate between groups of "believers" in respectively centralised or decentralised solutions realise that action needs to include all options in an integrated manner and the appropriate solutions really depend entirely on the local circumstances.

4.4 Financing access –possible roles of public and private actors

The finance necessary to implement universal access programmes across the region will be significant both in total number and in comparison to the national economies of many countries. The African Development Bank has estimated the financing needs to develop universal access to reliable electricity supply service and the results are presented in Table 4.1[39].

Table 4.1 Indicative financing required (in constant 2005 US$) to complete universal access to a reliable electricity supply service in Africa no later than 2030.

	GW production capability			Total investment Billion US$ (2005)				Average invest.: Billion US$ per year
	Net	Repl.	Total	Production	Transmission	Distribution	Total	
North Africa: 5 countries	60	22	82	82	29	62	173	7.5
South Africa	47	30	77	77	5	10	92	4.0
Sub-Saharan Africa 41 countries	82.5	19	102	102	54	119	275	12.0
Island States: 6 countries	2.5	1.5	4	4	1	2	7	0.3
AFRICA	192	72	265	265	89	194	547	23.8

Source: AfDB (2008)[39]

Reflecting the current electrification levels there is clearly the largest need for financing activities in the Sub Saharan Africa countries excluding South Africa. Most of these countries do not have the necessary national funds to undertake major programmes on their own, and donor resources will not be sufficient to cover the gap. There is a strong need to engage private sector funding in ways that are compatible

with coordinated nationally led action, requiring the private sector only to engage in viable business opportunities.

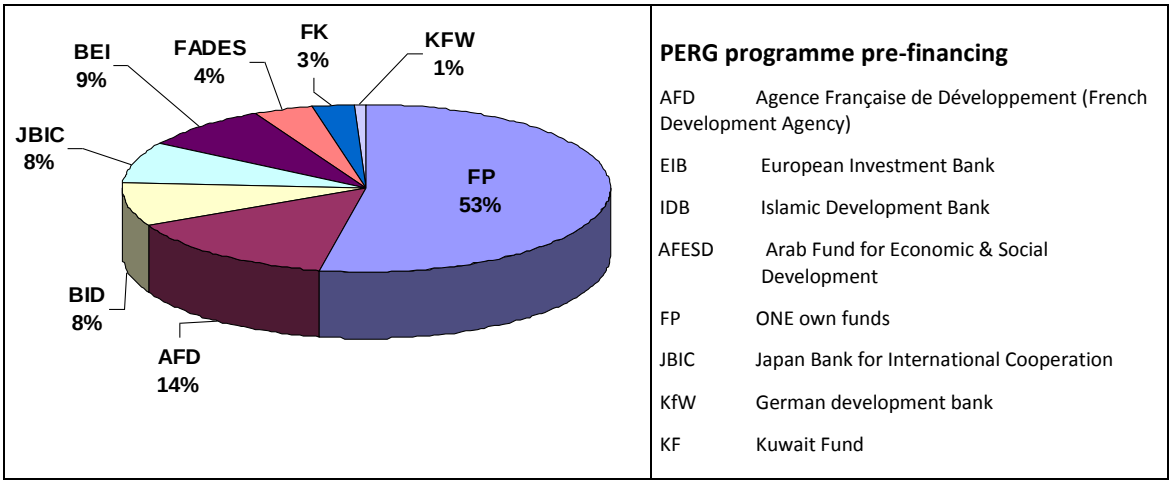
National funding, complemented in many cases by significant shares of international grants, will be required to ensure institutional strengthening and the planning and prioritization processes, while the actual implementation in many countries will need to focus on some form of public-private partnership arrangement.

As described in the Morocco and Ghana examples, the strong policy and institutional frameworks enabled a financing structure which involved central government or utility, local government and beneficiaries in a flexible financing model, which enabled the engagement of a number of bilateral and multilateral institutions in the overall financing package through grants or soft loans.

Figure 4.1 illustrates the combination of domestic, bilateral and international sources that provided the core financing for the Moroccan PERG programme[40]. The South African case relied to a larger extent on domestic public and utility funding, but has also engaged private sector in PPP arrangements especially for off-grid programmes.

Details of power sector investments are not widely available and the case studies for this paper have not focused especially in the financial aspects. Nevertheless, Eberhard et al.[23] have carried out a series of studies and estimations that reveal a very mixed picture across countries, depending on income levels, resource endowments etc. Their macro picture indicates that governments spend around US$ 5 billion annually on power sector investments, ODA from OECD countries for the energy sector in Africa has been expanding the last decade to around US$ 1 to 3 billion per year mainly in the form of concessional loans and a smaller amount of grant finance. Non-OECD countries like China, India and the Arab region collectively also invest in the order of US$ 1 billion per year in the power sector broadly and generally target large-scale supply in resource-rich countries. Foreign Direct Investment from private companies is roughly in the same order of magnitude, but has been quite volatile and linked with large scale investments coming through. So looking at the AfDB figures there is clearly a large gap between current action and the needs related to achieving full and sustained access.

Figure 4.1 PERG Programme pre-financing[40]



Eberhard et al.[23] present a lengthy analysis of possible options for filling this gap, which is beyond the scope of this paper as it relates predominantly to financing the central supply structure rather than enhancing access.

Rural industries may in many cases have a promising potential to supply electricity to local mini-grids by expanding their own supply to cover nearby communities. Many rural and biomass-producing industries are surrounded by clusters of households due to the presence of workers in the industry and the secondary economy that emerges as a result of this settlement. The efforts and investments of expanding power production are often marginal compared to the social and economic benefits for the community. In addition, subject to having a Power Purchase Agreement (PPA) with the electricity distribution utility, any excess electricity could be sold for distribution to the utility's electricity customers, if location permits.

The ability to attract private partners and capital to access programmes depends very much on the viability of the operational phase i.e. if it is possible to implement subsidy and tariff structures that in combination with government investments or guarantees can make the electrification sustainable in the longer term.

The next section will therefore address the issues of subsidies and tariffs and the experience gained from the case studies where the main message on this topic clearly was that *it is not possible to implement access programmes without some form of government subsidy. Tariffs need to be designed to make it possible for the target customers to connect and use the provided resource. At the same time tariffs and subsidies in combination need to ensure full cost recovery for the delivered service to make the provision viable in the longer term.*

4.5 Designing tariffs and subsidies to create sustained benefits for the poor

Morocco, Ghana and South Africa have all implemented some form of subsidy scheme for investments in delivery systems, especially for off-grid customers, and tariffs are generally socially adjusted to make them more affordable to the poor. Cross subsidies by higher-income customers typically in urban areas are common along with government-based financing. When combining the case experience with the World Bank results, it is not possible to point to one dominant approach, but it is uniformly reported that an investment subsidy is necessary in all cases, and tariffs need to be designed to fit the specific target groups and their ability to pay. The studies also point to the fact that subsidies should not only focus on the supply system e.g. the local mini-grid but also address the connection cost of the consumers and maybe even develop a system for how to finance appliances. Financing structures like the ones used successfully in Morocco with a small upfront fee and a multiyear amortization period may provide examples for nationally appropriate approaches.

Most countries in the African region operate with some form of a block tariff structure where the first block, typically up to 50 kWh per month is heavily subsidized and after that prices go up either gradually or to cost price directly. As mentioned South Africa has for some years operated with tariff where the first 50 kWh are free of charge. One challenge with tariff design is to ensure that the subsidies actually reach the target group and do not end up reducing electricity bills for the middle and high income

groups. This may in practice be very difficult to avoid but a number of more technical solutions have been implemented successfully like pre-paid meters for example with some smart card arrangement like is done in South Africa where only low-income consumers can purchase subsidized cards.

With major national access programmes the total cost of subsidies will need to be considered in terms of state budget implications, especially in countries where cross subsidies by more well-off customers will be limited. If the programmes lead to the desired economic development the net result will hopefully be very positive in the longer term. In the initial stages, however, funding for subsidies and tariffs needs to be ensured and sustained.

The World Bank studies underline the benefits of early focus on peri-urban electrification, as a way of building up the customer base, which later can facilitate elements of cross subsidization for extension of electricity to the remote rural areas, based on the general experience of "take-off" levels of electrification. The situation in peri-urban areas differs between cities and countries, but in most cases energy services are based on some form of marketed energy source, be it charcoal, kerosene or LPG, so introducing electricity is often easier than in the rural setting where part of the supply is non-market based. Analysis by the GNESD[3] show has shown that apart from affordability of electricity connection and tariff structures, one of the critical issues for peri-urban electrification is the legal tenure situation for the settlements. Many city councils do not want to recognize informal housing arrangements, and household or businesses with no legal tenure cannot be connected to the grid, which often leads to innovative "neighbouring" arrangements or outright illegal connections. Solutions therefore need to include not only electrification and development aspects but also elements of urban planning.

4.6 Role of renewable energy technologies in centralized and decentralized systems

The discussion has so far focused on electrification and access expansion and less on how this can be done as cleanly and efficiently as possible. The two set of issues are clearly interlinked as already described in Section 2.5 focusing on renewable energy technologies. With the current performance records for most power systems in the region it is clear that efficiency needs to be in focus all the way from production to end-use and there are many cost-effective approaches that are available. The issues are very diverse, however, and they have not been analyzed in any detail in the case examples. The role of renewable technologies on the supply side is better understood and some key issues can be extracted.

For off-grid stand alone provision PV solar systems have evolved into a reliable option that is increasingly being implemented in many developing countries. The pros and cons are well known. Reliability of systems is generally good and maintenance needs are limited, but systems are still quite costly and therefore limited to small amounts of power for mainly lighting and communication (including TV, radio and mobile phone charging), fluctuations in supply from variations in solar radiation are usually addressed by the storage systems.

As mentioned already, mini-grids can help to improve the reliability of supply compared to stand-alone single source systems. At the same time they have the ability to provide more energy and three-phase electricity making it possible to meet additional loads. Compared to PV home systems covering basic needs for lighting etc., mini-grids can provide electricity for community requirements such as drinking water supply, street lighting, vaccine refrigeration, schools, and for productive and commercial activities in shops and small businesses, including grinders and various machine tools and equipment. Technically several different renewable energy technologies can be connected to one mini-grid and in this way create more robust systems that are less dependent on a single and maybe variable resource. Indian mini-grid programmes, for example, typically include solar, wind and some form of bioenergy in a small local system, but the mix will depend on local resource conditions and system cost.

Mini-grids should be designed from the outset as a first step in a longer term, integrated access programme where connection to a central grid is expected later in the process, so they need to be "grid-ready". This issue, for example, has been addressed in recent Indian mini-grid programmes, where provision of grid compatible power conditioning units have been made mandatory in project design and smart grid technologies have been developed, so that if or when the central grid reaches the site, the mini-grids can be directly connected and if fact provide valuable additional capacity.

Existing diesel powered local grids in many African countries may offer an additional opportunity to increase the use of renewable energy in rural areas. The Government of Kenya has, for example, initiated a project to install solar PV and wind systems in existing off-grid systems using diesel power plants in arid and semi-arid areas to substitute part of the fossil fuels. This approach will result in an increased proportion of renewable energy in the local mini-grid system, as well as increased availability of electricity.

Introduction of renewable energy as a power source in the central grid system is also a major option and has become increasingly attractive for countries to reduce the pressure on the national power supply from high oil prices, or in some cases reduced production at large hydropower plants, due to droughts. Many countries in the region do have a fairly high share of production from large hydro systems, so this specific renewable source is already very important. With significant hydro resources still unexploited it is expected that the share of hydro in the regional supply will continue to go up.

Other renewable technologies are, however, starting to make a real impact and for example the use of geothermal sources is expanding significantly in Kenya and is being explored in other countries along the Rift Valley. Solar is still mainly used in the stand along and mini-grids mentioned above while the introduction of large scale wind farms are being examined in a number of countries. Since the 1980s, a series of large-scale grid connected wind energy projects were installed in Egypt, and 120 MW were added in 2010, taking the total installed wind capacity to 550 MW. South Africa and Kenya have wind power systems and are looking at plans for major expansion, such as a 300 MW wind farm near Lake Turkana in Kenya. Similar developments are is under way in a number of Northern African countries.

Decentralized feed-in of renewable energy electricity into the remote ends of the national grid can reduce transmission and distribution losses from centralized systems, which are sometimes as high as

20 %, and improve the local availability of electricity. It can thus contribute to the growing demand for electricity, and at the same time reduce the need to invest in centralized power generation, transmission and distribution.

Experience from other regions shows that it is important to introduce and implement appropriate quality standards of equipment and services when introducing new renewable technologies. Quality specifications for off-grid equipment may be mandatory to secure access to financing and for successful programmes it is important to reduce the use of poor quality systems.

Experience from Latin American off-grid systems indicates that many installations were neglected shortly after installation, and funds should be assigned for long-term technical and administrative support with focus on low income areas, based on the development of local capacity geographically close to the users. Close connection between technical and non-technical matters, and community involvement on the technical side is an important factor in the broader engagement process.

Thus, conclusions from the case studies and examples from other regions indicate that there is a significant potential for renewable energy technologies to contribute to electrification both via grid extension and through mini-grid and off grid systems.

Further expansions of renewable energy electrification will, however, require strong political commitment along with dedicated policies and regulation. Many of the issues raised in relation to long term planning for access programme are very similar for renewables, and integrating the two sets of issues will be the most effective way of ensuring success. This also implies the need for a better understanding of specific policy tools for grid integration like feed-in tariffs and opening of the grid for private power producers. Both have been successfully introduced, for example, in South Africa and Kenya and experience could form a basis for similar approaches in other countries.

4.7 Stimulating productive uses

A final issue for national access programmes to be raised here is the need for development integration. It has been emphasized throughout the report that inclusion of productive uses in the access definition is crucial in order for access programmes to have a chance of achieving the targeted economic development benefits. Experience from the case examples like in Morocco and Vietnam point directly to the need for dedicated efforts to link access with a focus on productive uses and other development efforts. The PVER programme in Morocco was established to address explicitly the lack of results from the early narrow focus on electricity. In each district the programme has engaged a broad range of stakeholders active in local development activities as well as ministries in charge of agriculture, tourism, business development, etc. combining a focus on introducing electricity for existing business use, as well as structuring programmes so that relevant components can be produced, installed or maintained locally.

As discussed in connection with the subsidy and tariff issues, it is necessary to include an assessment of financing needs and opportunities to obtain financing for businesses who would like to switch to electricity. The costs of connection and new machinery may be prohibitive unless some appropriate

financing scheme can be introduced. Direct subsidies may not be required in most cases, but enabling access to credit may be required to achieve the desired results.

At the national level it has already been underlined that the process of developing a national access programme should include all relevant actors and focus not only on the electricity side but really on access as an enabler of local development, entailing strong links to national and local development planning and a multi-sectoral approach. This focus is further emphasized in the next chapter where the areas for international cooperation and support are highlighted in direct response to the key issues for electricity access programmes at the national level, discussed in this chapter.

5 How can the international community best support national processes?

Most recipient and donor countries along with all major international organizations adhere to the Paris Declaration and Accra Agenda for Action[41]. This means that development collaboration should be founded on five core principles:

- National ownership
- Donor alignment with national priorities
- Donors seeking to harmonize in-country support
- Focus on clear goals and results
- Donors and recipient countries are mutually accountable for achieving these goals

Based on the discussion of priorities for national action in Chapter 4 and identification of some key conditions for successful electricity access expansion, this final chapter will suggest ways in which the international community broadly, and donors and finance institutions collectively and individually can support enhanced national action on providing large scale electricity access in line with the principles listed above.

5.1 Creating the political momentum

Political commitment was identified as the single most important pre-condition for successful access expansion at the national level. The same argument would apply broadly to the international donor community. Unless the importance of enhanced energy access for economic development and MDG achievement is fully recognized by the international community, it will not be possible to generate the financial and technical resources required to support the many poor and institutionally weak countries, especially in Sub-Saharan Africa, in establishing and implementing integrated electricity access programmes.

As mentioned in Section 4.1, national political commitment can be established or enhanced in different ways. Demand for cleaner and more efficient energy services from local communities may in some

countries be strong enough to create the necessary momentum on its own, a political champion who takes on access expansion as a personal cause has been seen to make a difference in several countries. The international community at large and major development partners can play an important role from outside to creating political awareness around the development benefits of enhanced access.

The current strong international focus on "sustainable energy for all" led by the UN Secretary General and the General Assembly decision to dedicate 2012 to that theme has - combined with a broad-based media campaign - raised the issue of energy access in many political fora around the world. Combined with the successful efforts to bring energy access for all into the list of themes of the negotiations for Rio+20, it means that almost any international or regional energy meeting held in 2012 will have on its agenda energy access promotion and the positive developmental impacts of increased access.

There has not been a similar international political push in several decades and it builds on an already emerging enhanced dialogue between countries and development partners on the broad importance of the energy sector, reflected for example in the increased focus in recent years on energy issues in many national poverty reduction strategies.

Political partnerships like the EU – Africa Energy Partnership[42] provide another type of forum where awareness raising can take place for both donors and recipients and joint programmes can be established. The partnership has a strong focus on access, but still mainly at project level.

5.2 Strengthening institutions and policy development

With the country cases and analytical studies supporting the need for a strong national institution responsible for planning, prioritization and managing implementation of any major national access effort, a key priority for donors should be to support the strengthening of relevant capacities in the relevant institutions. This will include areas such as policy analysis, forecasting and modelling, technical expertise, especially related to renewable options, legal and financial capability and links to relevant development expertise and ways to create multi-stakeholder engagement.

Needs differ between countries but it may be useful to refer back to the electrification statistics in Section 3.1 and the discussion of "take off" levels where the existing framework can become institutionally and technically self-sustaining. Countries like South Africa and many North African countries have reached high electrification levels where there may be a small but difficult remaining challenge, but where the existing structures can, broadly speaking, manage the process and the need for outside support is minimal.

The middle range countries like Ghana are likely, as in the Ghanaian case, to have relatively well established policies, plans and institutional frameworks so the need for international support may be more targeted towards financing of expansion plans and technical innovation around mini-grid and off-grid solutions. This may be particularly the case for the national public institutions while there may be a strong need to build technical and financial understanding and expertise in the private sector to better engage in and benefit from the electrification programme, especially where there are aims to increase the renewable energy share of power production. Finance institutions are traditionally risk averse and

need to understand the business case for renewable energy which often differs at least structurally from traditional power financing. Similarly there may be a need for stimulating stronger engagement at the regional and community levels where outside assistance could be important, especially if it involves expertise from the same levels in other countries and NGOs already active in local community development issues.

Finally, the many countries where current access levels are around 10 to 20% are the ones where significant scale-up will require substantial international support for most parts of a national programme, but initially mainly technical assistance to establish the policy and institutional framework to lead the process. As mentioned earlier many of these countries have relatively poorly performing electricity sectors in general and it may be necessary to take much broader and extensive action than just providing support for a national access programme. While this problem is of fundamental importance it is really beyond the scope of this report. It is clear, however, that it will be very difficult to build a sustained access programme without simultaneously addressing the wider sectoral problems. It is nevertheless possible to move in parallel, especially because a large part of the initial action on access is likely to be on decentralized options, probably focusing on mini-grid systems.

Support for private sector, local government and community engagement would be needed in similar ways as described for the middle group of countries.

5.3 Stimulating regional cooperation

Countries at the low electrification levels would likely be able to benefit from countries that have made strong progress, so inter-regional exchange and technical assistance programmes should be part of the actions stimulated by international support. Thus, what is increasingly referred to as peer-to-peer learning and South-South collaboration would constitute important components of the institutional support.

There is already emerging sub-regional collaboration around the so-called power pools. The best established is the Southern African Power Pool, which has been in existence formally since 1995 and has developed over time both long and short markets enabling daily internet-based trading. The other three regional pools for West, East and Central African countries are less mature and the traded amounts of electricity are still limited. Expanding the regional power systems faces a number of technical, economical and political barriers related to the need for costly enhanced transmission systems, development of real markets and market-based pricing while allowing for necessary large scale power supply investments. Finally, the political stability of many countries is still fragile meaning that it is risky to rely on imports, and governments may want to have control over supply. Nevertheless, the potential benefits are significant in terms of the potential to utilize the large untapped hydropower resources available within the region and simply the scale of the systems to provide more reliable supply to existing and new customers.

The power pools are mainly relevant in relation to creating a better functioning electricity sector in general, which as discussed in the previous section is necessary for national access programmes to become successful. Collaboration at the sub-regional level may, however, also be very relevant for

aspects related to access programmes. The most direct example is bilateral collaboration across borders where a settlement in one country may be located closer to electricity systems in the neighbouring country, and cross border connection can provide easier access than a national option.

Other types of sub-regional collaboration that may not involve the power pool arrangements directly could be joint development of equipment for mini-grid and off-grid systems where standardization of components and local involvement in production would bring clear cost reductions and enhance local economic benefits. Some experience exists in the areas of energy efficiency equipment and joint standard setting in the Southern African sub-region. Even if implementation is a challenge, this would represent a very promising area for regional collaboration and support from outside donors, along with technical cooperation with relevant Northern institutions, could provide a significant boost to mini-grid expansion as part of the overall national programmes.

Coordinated action at the sub-regional level may also in general be able to create sufficient market potential to attract or develop new businesses. A prime example is within the area of renewable energy technology where national markets in smaller countries may be insufficient to sustain viable businesses. Detailed analysis of regional trade barriers and import rules would be required before any action was decided, but in favourable cases there are likely to be good opportunities for boosting employment generation in connection with the national access programmes.

5.4 Providing targeted financing

The importance of donor financing for African power sector development was illustrated in Section 4.4. Provided there is international willingness to support a major scale-up of energy access, either as a Rio+20 target or just as a development cooperation priority, there will be a strong need for increased funding from bilateral and multilateral donors, as well as finance institutions, for dedicated access programmes.

Reflecting priority actions at the national levels discussed in Chapter 4 it is necessary that increased and sustained international grant financing is made available for:

- Strengthening the institutional structure for planning and implementation at both national and local scale, including specific support for increasing the renewable energy uptake in programmes
- Contributing to the sustained financing of required subsidies for access programme expansion and tariff structures that will actually allow the targeted poorer part of the population to benefit fully.

In addition, the existing concessional funding opportunities for the electricity sector need to be increased and preferably targeted more towards access programmes. Mini-grid expansion in particular may need a specific financial windows to allow for a significant scale up.

In times when official ODA is actually declining this will be a real challenge, as it will require difficult prioritization exercises. Engaging the rapidly growing private foundation funds in access support may be

one way by which the international community could tap significant new resources. But it should be stressed that access should not be about new technology showcases with “ribbon cutting opportunities”, but is really about addressing basic development issues and addressing the fundamental needs of some of the poorest people on earth.

5.5 Donor coordination at national and international levels

It may be trivial to discuss donor coordination when it is already listed as one of the basic principles that most donors and countries adhere to. But if the aim is to provide massive scale up of electricity access in a large number of African countries the challenge can only be overcome if all actors work closely together.

This will imply collaboration both at international level to ensure prioritization of energy access in all the major development organizations and multilateral finance institutions, if relevant with some significant central funds set aside to assist on a long term basis. It would be immensely important if the major donors could align around a set of principles for energy access support, so recipient countries would not receive confusing signals and have to adhere to many different approaches. On the other hand it is clear from the analysis that this should not turn into a “one size fits all” approach, which was the case with many of the energy sector reform efforts, resulting in very mixed results.

Coordination of country priorities would also be highly desirable so that donors do not end up focusing on the “usual” ten to twenty countries, but really take a wider regional engagement, if relevant using sub-regional collaboration as a lever with countries that are not able to move forward on their own.

Finally, in-country coordination of effort remains crucial, but here both the international organizations and the bilateral donors are already quite advanced on ensuring internal coherence. A more cross-sector approach may, however, need to be introduced to ensure the focus on especially productive uses and economic development. If access programmes are to deliver the desired benefits both in terms of social and economic development it is not enough to consider it an energy sector issue. It is necessary to think energy access into industrial, agricultural and other sectoral and rural development activities.

5.6 Internal donor coherence

A number of the issues mentioned in relation to donor coordination are also relevant for the internal activity organization of many donors. For assistance, in order to be successful donor support for energy access needs to reflect the national priority action areas, as outlined in Chapter 4, but it is also necessary for many donors and international organizations to take a hard look at the internal organization of their support to access. For example, the balance between different instruments like technical assistance, grants and loans, and the integration of energy issues into other sector programmes has to be considered carefully. Additional funding for access programmes will be required, but a lot of synergy can be gained from focusing on integrated action where energy is seen as part of most development efforts and an important enabling factor of employment generation.

The issue of long-term commitment is also important at the individual donor level, but international organizations and funding arrangements may provide a buffer against shorter term political changes in the same way that strong institutions in recipient countries may carry programmes forward even if political commitment is weakened in period.

5.7 Puling it all together – need for integrated action

This section is deliberately left open till after the presentation of the paper on 20 April to benefit from the discussions and advice received.

References and notes

[1] The abbreviation RE is used exclusively in this report for "renewable energy" while it is realised that RE is often also used for "rural electrification". To avoid misunderstanding, the latter is always spelled out in full in this document

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[22] Data from a few countries (e.g. Cameroon and Gabon), where data was otherwise available, have been excluded from the plot due to suspect anomalies in the data which are probably due to different definitions of electricity access between data points.

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- A tool for planning and correctly selecting technological options;
- A tool for calculation/electrical optimization of LV and MV grids allowing for non-three-phase technologies and independent production, and aimed at studying the impact of power grid extensions;
- Software for the calculation/mechanical optimization of LV and MV grids.

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