Evaluation of Socio-Political factors responsible for the energy poverty in Sub-Sahara Africa[1]

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ABSTRACT

Poverty is the most fundamental reality of developing countries and the energy consumption patterns of poor people tend to add to their misery and aggravate their poverty. A direct improvement in energy services would allow the poor to enjoy both short-term and long-term advances in living standards. Required are energy strategies based on increasing the use of energy carriers other than biomass, or on using biomass in modern ways. Poverty alleviation and development depend on universal access to energy services that are affordable, reliable, and of good quality. For many years now, Nigeria as one of the Sub Saharan Countries has been facing extreme electricity shortage. This deficiency is multi-faceted, with causes that are financial, structural, and sociopolitical, none of which are mutually exclusive. For the purposes of this paper, after searching through copious amounts of literature, I was able to flesh out most of the financial and structural issues. With only this perspective, we naively attempted to compare cost projections for rural electrification, including both grid extension and decentralized methods. The projected costs are high but not so prohibitive as the current electrification statistics would suggest. We realized that there must be some aspect of the problem that cannot be reflected through numbers and official policies. The goal of this paper is not to solve the energy crisis of Sub Saharan Africa, but rather to introduce the depth and complexity of the issues involved. In the appendix, we describe various strategies that could be used to address the solution. The energy situation in Nigeria is quite different from that of the United States and other more developed countries. Yet alleviation of the global energy crisis will require a coordinated effort on the part of many nations. Thus, it is important to have a general understanding of the nature of problems in areas of the world less familiar to westerners.

1.0 INTRODUCTION

Human society cannot survive without a continuous use, and hence supply, of energy. The original source of energy for social activities was human energy—the energy of human muscle provided

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the mechanical power necessary at the dawn of civilization. Then came the control and use of fire from the combustion of wood, and with this, the ability to exploit chemical transformations brought about by heat energy, and thereby to cook food, heat dwellings, and extract metals (bronze and iron). The energy of flowing water and wind was also harnessed. The energy of draught animals began to play a role in agriculture, transport, and even industry. Finally, in rapid succession, human societies acquired control over coal, steam, oil, electricity, and gas. Thus from one perspective, history is the story of the control over energy sources for the benefit of society.

Modern economies are energy dependent, and their tendency has been to see the provision of sufficient energy as the central problem of the energy sector. Indeed, the magnitude of energy consumed per capita became an indicator of a country's 'modernization' and progress. Energy concerns have long been driven by one simple preoccupation: increasing the supply of energy. Over the past few decades, however, serious doubts have arisen about the wisdom of pursuing a supply-obsessed approach. Attention is shifting towards a more balanced view that also looks at the demand side of energy. But access to, and the use of, energy continues to be a necessary and vital component of development.

Energy poverty in Africa calls for priority attention from the international community. Indeed, the region's energy needs are huge, particularly in sub Saharan Africa, which has the lowest rate of electrification in the world – less than 30 percent, according to the UNDP Human Development Report 2007/2008. This rate is all the more unacceptable, when one realizes that the estimated population of sub-Saharan Africa is 16 percent of the world total. The sub-region depends largely on inefficient traditional biomass, used mainly for cooking and water-heating in households. Traditional biomass accounts for over 80 percent of primary energy demand. These sources of energy (firewood, charcoal and animal dung, for instance) burn inefficiently and give off noxious fumes, which can cause serious respiratory disease and even death. The surrounding environment is also degraded, through the depletion of forest resources.

Historically, expanded energy access, propelled by relatively inexpensive energy supply, played a major role in the large gains in productivity and rapid economic growth and significant reduction in poverty witnessed in the world economy in the last century. It is conventional wisdom that increased use of modern energy services per capita is an integral part of higher and sustained economic growth and significant improvement in living standards in low income developing countries. Arguably, expanded access to adequate, reliable, efficient, secure, environmentally responsive and affordable energy is a key element in Africa's quest to achieve sustained economic growth. Other vital elements are significant poverty reduction, substantial improvement in living standards and achievement of the Millennium Development Goals (MDGs). The context for realizing the central goal of achieving expanded energy access and minimizing energy poverty,

which will translate to substantially higher and more efficient per capita energy consumption in the shortest time possible, is defined by the following stylized facts:

- Africa is well endowed with energy resources, including oil and gas, yet most African countries are energy-poor and have low energy access;
- Significant energy demand-supply gaps exist, the most acute being in electric power;
- Domestic energy prices are high compared to most other developing countries;
- Contrasting demand and supply paths in the region reflect diverse initial economic and social conditions and energy resource endowment;
- Supply-demand balances reveal significant differences at sub-regional and country levels;
- Capacity utilization is low, resulting in significant dependence on expensive imports of petroleum products and unreliable and poor quality of electricity supply;
- Poor regional and intra-regional energy infrastructure linkages have exacerbated the cost of domestic supplies especially in landlocked countries;
- The problem of access is more pronounced in rural areas of Africa where the majority of the population lives. The problem of energy and income poverty is also more acute in the rural areas;
- The relatively weak state of economic and social conditions in most economies in the region, which is the world's poorest, follows almost two decades of poor economic performance and deepening poverty.

Furthermore, global energy market developments and the countervailing policies of major energy importing and exporting countries have brought the era of inexpensive energy to an end. These external developments have made the challenges facing expanded energy access and the elimination of energy poverty in Africa more overwhelming. Arguably, the sharp increase in world energy market prices since 1999 has made Africa's drive to achieve affordable and expanded access to energy and sustainable development, as embodied in the MDGs more challenging. For example, higher prices have pushed access to refined petroleum products beyond the reach of hundreds of millions of low-income households, especially in rural areas. This and other developments associated with structural adjustment and related economic reform measures have reversed the meager improvement in living standards and economic well-being in the post-adjustment period. With low income and higher fuel prices, the result has been increased recourse to biomass fuels with their obvious environmental consequences. There is general agreement that the adverse effects of higher world energy prices on domestic energy supply, access, economic growth and sustainable development, have been more severe in Africa than elsewhere. Poor access to modern energy services constitutes a major constraint on the exploitation of economic

opportunities, sustained economic growth and the achievement of higher living standards in the continent.

2.0 LITERATURE REVIEW

ENERGY POVERTY IN AFRICA

Recent macroeconomic data indicates that sub-Saharan Africa (SSA) economies are undergoing rapid expansion, with a real Gross Domestic Product (GDP) growth rate of 6.5 percent in 2007. The improving terms of trade, as exemplified by the solid global demand for commodities, greater inflows of capital and the debt relief schemes are some of the salient factors contributing to the high growth rates.

However, the great challenge facing SSA economies is how to reduce poverty by half, by the year 2015, in line with the first objective of the Millennium Development Goals (MDGs). Specifically, the targets are to reduce by half the proportion of people living on less than a dollar a day and also cut by one-half the percentage of people suffering from hunger.

These goals call for GDP growth rates that are even higher than the current achievement. The implication is for higher levels of domestic investment and productivity of the economy in order to attain this goal. Thus, real GDP growth rates should be 7 percent or more per annum. Yet the productivity and overall performance of SSA economies is being hampered by the state of the energy sector. Lack of energy services or poor access to this resource, are some of the factors militating against SSA economies' ability to realize their higher potentials.

Measures to overcome this problem have engaged and are continually attracting the attention of governments, the international lending agencies, non-governmental organizations and the various stakeholders. The OPEC Fund for International Development (OFID) organized this workshop to further deepen the discussions. The main purposes are to elucidate the issues and find appropriate answers that will keep SSA on a much more robust growth path towards achieving the key targets of the MDGs.

ENERGY RESOURCES

Africa's landmass of 30.3 million km² is endowed with rich natural resources including fossil and renewable energy. Yet most of these resources are yet to be exploited. It has been estimated that Africa's energy resource endowments with respect to the world totals are in the following order of magnitude:

Oil	**9.5 percent**
Coal	**5.6 percent**
Natural Gas	**8.0 percent**

The sustainable development of these energy assets will ensure that national resources are managed to meet the needs of the present and succeeding generations. However, large foreign investments are required to develop these resources.

CURRENT SITUATION

Energy supply is given as a target indicator for achieving the seventh objective of the MDGs, which is to ensure environmental sustainability. Africa is energy poor, a situation that has diminished the continent's productive capacity. SSA in particular depends largely on inefficient traditional biomass used mainly for cooking and heating water in households. Traditional biomass accounts for over 80 percent of primary energy demands. These sources of energy – for example, firewood and charcoal – burn inefficiently, thereby giving rise to energy loss. The surrounding environment is also degraded, through the depletion of forest resources. Pollutants (carbon monoxide, benzene, nitrogen oxides, etc.), which are also health-damaging substances, are emitted when these forms of energy sources are used indoors. Also, deaths from indoor air pollution, arising from the burning of biomass fuels, are substantial. Table 1 shows that SSA has the lowest measure of energy production, accounting for only 6.4 percent of world energy output. Total SSA production in metric tons of oil equivalent was 715.4 million, compared to 4,450 million for high-income countries, 5,604 million for middle-income countries and 6,767.1 million for low and middle–income countries combined. This performance is all the more unacceptable, when it is realized that the estimated population of SSA is 16 percent of the world's total. In Africa, energy use per capita is very low, compared to other regions of the world. Table 2 indicates an energy usage per capita of about eight times for high-income countries, compared to the usage level of SSA. The figures for low/middle-income and middle-income countries are 2 and 1¼, respectively.

Also, on average, per capita annual growth rate of energy use was static during 1990–2004 for SSA, compared to about 1 percent for the high income and 0.2 percent each for the other regions of the world. Energy supply, as a target indicator, should be given a higher priority for Africa to achieve robust economic growth and produce enough goods and services, all of which are necessary for the attainment of sustainable development. Therefore, a reordering of priorities addresses the energy poverty issue. There is the need for further investigation, to enable African countries, characterized by energy poverty, to overcome the problem of access to energy services, as a basis for creating sustainable development.

SOCIO-POLITICAL PROBLEMS OF THE CURRENT ENERGY SYSTEM IN NIGERIA

NEPA's severe technological deficiencies are prevalent throughout the power system, both upstream and down. For example, with modern technology about 40% of the energy consumed in thermal plants can be converted to electrical energy. In the absence of this technology, as currently the case in Nigeria, this figure can be as low as 12%. Of the power that is produced, there is further loss through transmission. One estimate claims that between 30 and 35% of power generated in Nigerian power stations is lost in this way. By comparison, power losses across lines in the United States usually come to less than a percent, even across greater distances. It is impossible to determine exactly how much of this inefficiency is due to illegal users' tapping the lines, but it seems likely that underinvestment in technology is the greater problem. Lack of modern standardized components and qualified maintenance staff pose serious problems for adequate electricity generation and supply. Various sources indicate that Nigeria's installed generating capacity is between 5000 and 6000 MW. Yet, by the government's own admission, actual output has never exceeded 4000 MW. In reality, the actual output is usually far below this. Never mind that actual electricity demand including off-grid generators is believed to be closer to 10,000 MW. Below are articulations of the particular problems associated with each aspect of the energy sector.

Hydropower: There are many problems associated with hydropower:

1. The current infrastructure of the hydro plants is in dire need of rehabilitation and the actual energy output of the plants is far below their projected capacity.
2. The output of the hydro plants is highly oscillatory according to the seasonal droughts.
3. The trends of climate change have led to a continual loss of water. Since the power output of hydro plants is dependent upon the flow of the river, with less water, there is less potential energy to harness, making hydropower a less desirable energy source.
4. Two rivers, Niger and Benue, account for the majority of hydropower generation. Prior to entering Nigeria, the rivers pass through Niger and Cameroon (see figure below). In order to obtain the maximum amount of energy from these rivers, Nigeria must provide incentives to prevent Niger from installing their own dams on the rivers. Thus, a portion of the energy generated by the hydro plants is exported to Niger to compensate for their agreement not to build dams along the river. Thus, Nigeria receives even less of the already dwindling electricity generated form existing hydropower.

Oil and Oil Refining: Most of the oil extracted in Nigeria is exported: about 2.2 million barrels per day. In 1999, there was very little oil consumption within Nigeria (about 100,000 barrels/day). That year, the country gained independence from military rule and a democratic government was

put in place. With this transition came the enlargement of the middle class, leading to an exponential increase in automobile use and thus oil consumption. Although Nigeria is the 11th largest oil exported in the world, the refining capacity of the country is very minimal. The projected refining capacity only supports 445,00 barrels a day, and the actual output of these refineries is far below capacity. Additionally, the refineries do not capture the gas that is given off in the refining process and it is instead burned as flares. In most countries this gas is captured and re-inserted into the ground; however, this process requires additional pressurized tanks. It is estimated that significantly more than half of Nigeria's natural gas is given off as flares. Thus, a huge amount of valuable fuel is simply burned off. This process is also very detrimental to the environment.

Liquid Natural Gas (LNG): Nigeria has a large source of liquid natural gas (LNG), 163 trillion standard cubic feet. The Nigerian energy sector has begun the development of the necessary infrastructure to utilize LNG to contribute to the national grid capacity. This process involves building pipelines to transport the LNG to the power plant as well as building the power plants themselves to convert LNG to electricity. The construction of the pipelines is still underway; however their stability is marginal as there have been numerous instances of sabotage to the structures themselves. This is not the most pressing problem. Concurrent with the development of pipelines for internal use, a pipeline to divert LNG to parts of Europe was also developed. The motivation on the part of the European nations was to decrease their own dependence on Russian LNG. These pipelines are now functional, and as a result, all of Nigeria's LNG resources for the next six years are tied up in the piping to Europe and consequently there will be no available LNG to use internally. Thus, despite the infrastructure in place, the country cannot harness this energy.

The Grid Structure: The grid structure is unstable and vulnerable to sabotage (see map below for the layout of the grid). Some of the problems associated with the grid structure are:

1. People are able to connect their residence or industrial enterprise to the grid without a meter. This is one source of how power is leaked during transmission.
2. There are zoning issues that wreak havoc on the system. In some cases, a property will be zoned for a residence; however, these designations are not enforced. Rather than a residence, the property could be used for industrial purposes, which often use more energy. This discrepancy can overwhelm the grid and cause a transformer to explode.
3. Due to the prospect of privatization, there is a propensity to physically sabotage the grid system through dismantling parts of the grid itself

Generators: Due to the lack of reliable electricity, many people and companies supplement the electricity provided by the grid system with their own generators. In fact, most everyone who can

afford a generator owns one. According to one approximation, well over 90% businesses have generators. The electricity from private generators is more expensive than that from the national power grid, thus raising the price of domestic goods. Efforts to alleviate this strain are met with opposition from the companies who import generators, as they have created an extremely lucrative industry. There is suspicion that some of the grid system sabotage is from members of this industry.

Fuelwood: In rural areas, much of the energy production is from the burning of fuelwoods. This practice has a host of associated problems.

1. The emissions given off from this process are toxic, especially if done in doors, which is often the case.
2. There is a trend of deforestation in Nigeria at 300,000 hectares per year [8]. This is mainly due to the growth of the timber industry; however, deforestation is propagated due to fuelwood burning. The scarcity of wood as a result of deforestation makes the process of cooking with fuelwood even more unsustainable. The average time it takes one person (usually women) to collect enough wood for the day's meals (2.28 on average) is 4-6 hours. With deforestation the time it takes to collect this wood will only get longer.
3. The overall efficiency of the commonly used three stone stove is less than 10%. Despite the availability of more efficient stoves and cooking fuels, these alternatives have been adopted for both financial and cultural reasons.

Levels of Governmental Co-operation: There are three levels of government in Nigeria composed of the national government, 36 state governments and 772 local governments. The energy problems of Nigeria are rampant across the entire country, and thus many of the energy decisions have to be coordinated between all levels of government. There are, however, instances of small-scale grid structures that are fully functional. In fact, one state has developed their own grid and is now selling some of the generated electricity back to the national grid. In this light it is evident that sometimes state and local governments can enhance the local grid structure unilaterally.

SUB SAHARA AFRICA'S POWER SECTOR IN INTERNATIONAL PERSPECTIVE

Sub-Saharan Africa (SSA) faces major infrastructure challenges, the most severe of which are arguably those in the power sector. Not only is SSA's energy infrastructure meager compared with other regions' but electricity service is costly and unreliable. Indeed, in recent years, more than 30 of the 48 countries in the SSA region have suffered acute energy crises.

The entire generation capacity of the 48 countries of SSA, at 63 gig watts (GW), is comparable to that of Spain. If South Africa is excluded, SSA's generation capacity falls to 28 GW, which is about the same as Argentina's. Normalizing for population, and subtracting South Africa, the installed capacity of SSA is only one third of South Asia's, and about a tenth of that of other developing regions (Figure 1.1a). Moreover, SSA's generating capacity has been stagnant for many years; its growth rates are barely half of those in other developing regions (Yepes, Pierce and Foster, 2008). To make matters worse, as much as one-fourth of SSA's plant is currently not in operating condition.

Rates of electrification are correspondingly low. Some 24 percent of SSA's population has access to electricity versus 40 percent in other Low-Income Countries (LICs), and electrification is proceeding more slowly. Electricity consumption in SSA is a fraction of consumption in other regions and, excluding South Africa, is only about 124 kilowatt-hours (kWh) a year, less than a tenth of China's. Although electricity tariffs in some SSA countries have been kept low, the cross-country average tariff is rather high at $0.13 per kWh – about double those in other parts of the developing world and almost as high as in OECD countries. Nevertheless, the prices fail to cover costs.

As a result of such low power consumption, the contribution of SSA's power sector to global CO2 emissions is no more than 520 million tons per year, with South Africa being by far the major contributor. In all other SSA countries, the bulk of greenhouse gas emissions come from land use and deforestation. While power consumption in SSA will need to grow substantially to meet unsatisfied demands, a significant share of the increment could be met from hydro-power, thereby mitigating the climate change impact. For example, in Southern Africa alone, it has been estimated that greater regional trade could reduce incremental carbon emissions by 40 million tons per year. Also, unreliable supply adds to the cost. African manufacturing enterprises report power outages on an average of 56 days a year, costing firms 5-6 percent of revenues. That is why many firms operate their own diesel generators, at a cost of about $0.40/kWh. In the informal sector, where firms rarely have the capital for backstop generation, lost revenues from power outages can be as high as 20 percent.

Deficient power infrastructure dampens economic growth and weakens competitiveness by, for example, the detrimental effect on productivity. Escribano, Gausch and Pena (2008) estimate the impact of infrastructure on firm productivity relative to other variables and also decompose the contribution of various components of infrastructure. They find that in most SSA countries, infrastructure accounts for 30-60 percent of the adverse impact on firm productivity, well ahead of factors like red tape and corruption. Moreover, in half the countries analyzed, power accounted for 40-80 percent of the infrastructure effect. In another study (Calderon 2008), simulations based on panel data show that if the quantity and quality of power infrastructure in all SSA countries

were improved to that of a better performer (Mauritius), long-term per capita growth rates would be higher by as much as 2 percentage points. The scarcity of power in SSA also affects delivery of social services and the quality of life. Without electricity, clinics cannot safely deliver babies at night or refrigerate essential vaccines. Lack of illumination restricts the ability of children to study at night and fosters crime in peri-urban areas.

SUB SAHARA AFRICA'S ACUTE POWER PROBLEMS AND ITS UNRAVELING PARADOXES

Africa's overstretched electricity systems have become exceedingly vulnerable to supply shocks, resulting in widespread outages and load shedding. With economic growth in the past decade raising demand for electricity, the lackluster expansion of generation and transmission facilities has stripped away any cushion from excess capacity that may have existed. In recent years, when droughts reduced power in the hydro-dependent countries of East Africa, prolonged blackouts became commonplace. In countries like South Africa, plant outages for maintenance have had serious consequences. Countries whose power infrastructure has been damaged by conflict have also suffered severe shortages. And high petroleum prices have created enormous cost pressure in countries like those of West Africa that depend on imported oil products for electricity generation.

An increasingly common response to the crisis has been short-term leases for emergency power generation to a handful of global operators. Though this capacity can be put in place within a few weeks, it is expensive. The costs of small-scale diesel units, for example, are very high, typically about $0.35/kWh. The equipment is typically leased for up to two years, after which it reverts to the private provider. An estimated 700 MW of emergency generation are currently operating in SSA; this represents more than 20 percent of installed capacity. The total price tag ranges from 0.5 percent of GDP in Gabon to 4.3 percent in Sierra Leone. The recent energy crises are symptoms of a deeper malaise, the causes of which need to be understood and addressed. Four paradoxes shed light on the very complex challenges that need to be faced: abundant energy but little power; high prices but even higher costs; widespread but ineffective reform; and high expenditure yet inadequate financing.

PARADOX 1: ABUNDANT ENERGY BUT LITTLE POWER IRONICALLY

SSA is richly endowed with both renewable and exhaustible energy resources. At present, for instance, it exploits only 8 percent of its gross hydropower potential of 3.3 million gigawatt-hours (GWh) annually. The countries on the Gulf of Guinea hold 4.9 percent of the world's proven oil reserves (some 60 billion barrels) and 7.8 percent of proven natural gas reserves (some 14 trillion cubic feet); if converted to electricity, the natural gas currently flared during oil production could itself meet a substantial share of Africa's power needs. Southern Africa is rich in coal. Botswana,

South Africa and Zimbabwe together hold 5.6 percent of the world's proven reserves (more than 50 billion tons). There is also significant geothermal potential in the Rift Valley. However, the continent's energy resources tend to be concentrated in a handful of countries whose physical and political barriers to trade make it difficult for them to access centers of power demand. And their economies are too small for them to develop their own resources. For example, the Democratic Republic of Congo (DRC) alone accounts for about 40 percent of SSA's hydroelectric potential, and Ethiopia accounts for another 20 percent. But both are far from the economic centers in Southern, Western, and Northern Africa, and the multi-billion dollar investments needed to exploit hydro-potential are too big for their economies. Moreover, in most SSA countries, energy markets are too small to take advantage of efficiencies from large-scale electricity production. With today's technology, full economies of scale in thermal power generation begin at about 400 MW; national power systems meet this threshold in only 14 countries in SSA. In another 14, power systems have only 100 MW of capacity. With relatively little cross-border trade, many SSA countries use technically inefficient forms of generation. In Eastern and Western Africa, about a third of installed capacity is diesel-based generators. These countries have few domestic energy resources of their own, even though there are sufficient hydro and gas resources in neighboring countries to support much lower-cost forms of generation. The consequences of this technically inefficient pattern of power generation become evident when average operating costs of different types of power systems are compared. The average for predominantly diesel-based power systems is as much as $0.20/kWh more expensive than the cost of hydrobased systems.

PARADOX 2: HIGH PRICES BUT EVEN HIGHER COSTS

The variation in electricity charges across SSA countries is huge. It spans some of the cheapest power in the world (at less than $0.05/kWh in hydro-based systems and in South Africa based on cheap coal) to some of the most expensive power in the world (at over $0.30/kWh in countries with diesel-based systems and landlocked or island geography such as Chad and Madagascar). Nevertheless, looking across countries, the average charges today look high by international standards and are a result of recent increases reflecting higher oil prices and tightening supply conditions worldwide. The overall average revenue has risen from $0.07/kWh in 2001 to $0.13/kWh in 2005. In countries reliant on diesel-based power generation systems, average revenues have risen from $0.08 to $0.17/kWh. Yet the average revenue in SSA countries still falls significantly short of covering the average operating costs of $0.27/kWh. This is even though average revenue in hydro-based countries has risen dramatically, from $0.02 to $0.07/kWh. Despite such comparatively high average revenues, the vast majority of SSA countries are doing little more than covering average operating costs. The correlation between average revenue and average operating cost is as high as 90 percent, indicating that operating cost recovery is usually the driving principle behind power pricing. Nevertheless, once average operating costs exceed $0.20/kWh, there is a tendency to price below the 45 degree line. The implication is that past

capital costs of power-sector development have historically been almost entirely subsidized by the state.

PARADOX 3: WIDESPREAD BUT INEFFECTIVE REFORM

Although they are somewhat behind the reform programs in other regions of the world, SSA countries also embarked upon the path power-sector reform orthodoxy. This included reform legislation and sector restructuring to pave the way for competition in generation and private sector participation across the electricity supply chain. As of 2006, more than 80 percent of SSA countries had enacted a power-sector reform law, 75 percent had experienced private participation in power, about 66 percent had corporatized their state-owned utilities, more than half had established a regulator, and over a third had independent power producers. Yet a few countries have adopted the full range of reform measures.

The lack of results has forced a rethinking of whether certain reform principles and programs apply in SSA. One reform that has not been widely adopted in SSA is unbundling of generation, transmission, and distribution functions to create competition in generation and supply. Besant-Jones (2006) in his global review concluded that restructuring the power sector to advance competition only made sense in countries large enough to support several generators above minimum efficient scale. The power systems in most SSA countries are so small that this prescription is largely irrelevant for them. Nevertheless, even in the largest countries, where unbundling could work, there has not been much progress.

Almost half of these have been independent projects, with the utility signing Power Purchase Agreements with the private sector to build green-field generation plants. With more than $2 billion of private investment these have provided nearly 3,000 MW of new capacity, which is a substantial contribution to available capacity. An independent assessment concluded that these projects can be relatively costly due to technology choices, procurement problems, and currency devaluation, and are often subject to renegotiation (Gratwick and Eberhard, 2006). A poorly documented issue is the extent to which Power Purchase Agreements are creating contingent liabilities for the state. The rest of the transactions have been concession, lease, or management contracts typically for operation of the entire national power system. These have had a relatively high failure rate; because about one-third of the contracts are currently in distress or already canceled. However, in the more successful transactions performance has improved noticeably. The usual reasons for failure are the lack of financial viability or creditworthiness of the utilities – governments have been unwilling or unable to adjust tariffs to enable cost recovery or pay subsidies to make up the difference – and the lack of access to funding for priority investments to improve efficiency or expand services.

PARADOX 4: HIGH EXPENDITURE BUT INADEQUATE FINANCE

SSA countries on average spend 2.7 percent of their GDP on power; and a significant number spend more than 4 percent (Table 2.3). Typically, more than 90 percent of this spending is channeled through the national state-owned utility; while less than 10 percent appears on the central government budget. Operating costs absorb 75 percent of total spending. As a result, public investment in the sector is very low; on average only 0.7 percent of GDP.

The contribution of Official Development Assistance (ODA) to public investment in power has been modest, averaging only $700 million a year for the last decade. Also, support has been highly volatile, amounting to only a few hundred million dollars a year in the late 1990s, but rising toward $1 billion annually, in recent years. Despite the substantial number of private transactions, their value has averaged only about $300 million a year for the last decade, and once again the flows have been highly volatile because these investments are lumpy. Thus, total external capital flows to the power sector in SSA amount to no more than 0.1 percent of the region's GDP.

3.0 RESEARCH METHODOLOGY

The research was carried out using a qualitative method of research, and the research design is literature review and interviews. Articles on energy poverty and socio-political factors responsible for energy poverty were reviewed with emphasis On Sub-Sahara Africa. Collected data were analyzed qualitatively.

4.0 RESULTS AND DISCUSSION

The power sector in Africa is characterized by a set of paradoxes. There are abundant sources of power, significant levels of government funding, and notable efforts at reform. Yet, electricity access rates are very low compared to other developing regions, prices are high, and the power supply insufficient and unreliable. The policy choices that best address these paradoxes are not clear-cut. The traditional model that predominates in the SSA power sector – vertically integrated, state-owned monopolist utilities – has yielded disappointing results. Yet reform to increase efficiency and boost competition through private participation has in many cases failed to deliver the expected results. For example, unbundling is limited, failures of transactions and projects frequent, and there has been minimal additional investment. The lesson that emerges is that success in tackling the challenge is not a simple function of the model adopted. The power sector in Africa needs to move to a "mixed economy," characterized by a range of structures, regulation, and technologies adapted to each country's context. Successful interventions will tackle several problems simultaneously to put the sector on a positive trajectory of improved sector and utility management, financial viability, new investment, and better customer service. This means

recognizing that the power sector has quasi-monopolistic characteristics – particularly in grid-based distribution and to a lesser extent in transmission. Furthermore, incumbent utilities will continue to be the largest players in the sector for the foreseeable future. But interventions also need to be innovative and ambitious, recognizing that meeting customer needs means multiple providers, financial viability, and new forms of external financial assistance. Where certain preconditions are in place – including appropriate regulatory frameworks for public-private partnerships, reformed tariff frameworks and sufficient security of investment for investors-sector reforms can do much to facilitate the entry of strategic private partners. Consequently, the starting point is sustained and concerted action on three strategic priorities: (i) regional scaling-up of generation capacity, (ii) improving the effectiveness and governance of utilities, and (iii) expanding access through sector-wide engagement.

The three priorities are interdependent and must be tackled together. Efforts to boost generation and regional power trade will stumble if the utilities, which will continue to be central actors in the sector, remain inefficient and insolvent. Expanding electricity distribution systems without taking measures to tackle the shortages in generation and to improve transmission capacity would clearly be futile. And focusing exclusively on utility reform would be fruitless unless a start is made on substantial, long-gestation investments in both generation and access to improve quality of service and render the utilities viable. In short, these strategic priorities must progress together. At the same time, the period required to yield results from these actions is such that they need to be complemented by important short term measures. These include demand-side management, for example, the introduction of energy-efficient bulbs and loss-reduction programs such as enhanced bill collection and initiatives to tackle electricity theft.

- **REGIONAL SCALING-UP OF GENERATION CAPACITY**

The first strategic priority is to tackle the generation capacity deficit head-on. Africa's considerable hydro, gas and coal resources remain under-exploited. The best way to scale-up power generation at the lowest unit cost is to develop a new breed of large-scale projects. An initial wave of projects could include candidates like Inga III in the Democratic Republic of Congo, which is expected to add about 3,800 MW of capacity; the Temane Gas-powered Plant in Mozambique, 750 MW; Gilbe Gibe III Hydropower in Ethiopia, 1,800 MW and further development of generation capacity based on natural gas from Nigeria. However, individual countries do not have the necessary investment capital, or even the electricity demand, to move forward with these large projects. A project finance approach, predicated on regional power off-take in which private sector participation and donor funding are blended, is needed.

- **IMPROVING THE EFFECTIVENESS AND GOVERNANCE OF UTILITIES**

Shortcomings in how the power sector operates lead directly to many of the suboptimal outcomes detailed in this chapter. Tackling these shortcomings will require improvements in the regulatory and tariff framework at the sector level, as well as better management in utilities. The lack of strategic policy and planning for the electricity sector at central government level is a critical weakness. Interventions have been piecemeal rather than integrated. For example, many countries have focused on generation without investing in efficient transmission and delivery of power. A well-articulated plan for the sector will allow governments to move beyond the "firefighting" that has reduced their ability to plan for exogenous shocks, such as drought or high oil prices. Financial viability of incumbent utilities – and hence creditworthiness and access to domestic and international private capital – is important for the overall development of the sector. It demands that utility revenues allow at least the recovery of operating costs and ideally some contribution to capital costs. It means that in many cases, tariffs need to be gradually adjusted to levels that will allow these goals to be met, while remaining sensitive to the needs and capacity to pay of poorer households. The corollary of tariff adjustments is the need to significantly reduce operating costs to lessen the financial burden on consumers and of efforts to recover costs. Operational efficiency programs are needed to reduce the high rates of technical, non-technical (electricity theft) and collection losses. These can include capacity building and technical assistance to improve management, business practices and planning. Priority areas are improved load management (to better match supply with priority customer needs), theft-reduction initiatives and increased revenue collection through enhanced metering and better-run customer service units. Capital expenditure can also be driven down by using low-cost technology, as undertaken in Mali and Guinea. Innovations have included adjusting technical design standards to meet the reduced requirements of low-load systems, maximizing the use of material provided by local communities (such as locally sourced wooden poles), as well as the use of local employees and supervisors recruited from the community.

- **EXPANDING ACCESS TO ELECTRICITY THROUGH SECTOR-WIDE ENGAGEMENT**

The fact that power is often unavailable to lower-income groups means that those who do not have access are not benefiting from government or external financing. From a social, poverty-reduction and political perspective, it is therefore imperative to expand access. Yet financing expansion to lower-income households will further strain the financial viability of the power sector. Tackling this dilemma will require both significantly higher concessional financing from development partners for access programs, in addition to tariff increases and operating cost reductions. Given the scale of investments needed, a systematic approach to planning and financing new investments is critical. The current project-by-project, ad hoc approach in development partner financing has

led to fragmented planning, volatile and uncertain financial flows, as well as duplication of efforts. Engagement across the sector in multiyear programs of access roll-out supported by multiple development partners as part of a coherent national strategy will channel resources in a more sustained and cost-effective way to the distribution subsector. Coordinated action by development partners will also reduce the unit costs of increasing access. Such action will also create new sources of demand that will further make the case for large generation projects at the supranational level.

Since universal household electrification is still decades away in many countries, it is equally important that sector-wide programmatic approaches ensure that the benefits of electrification touch the poorest households, particularly deep in rural areas. While grid extension is often not economical for dispersed populations, off-grid models based on innovative renewable technologies can be cost-effective. For example, low-cost portable solar lanterns are one consumer product that could be accessible and affordable to the rural public, and the "Lighting Africa" initiative is supporting the development of the market. Solar-powered electrification of clinics and schools that provide essential public services to low-income communities is another way of directly bringing them the benefits of investment in electrification. Finally, it is important to recognize that most of the measures described above are medium term in nature, and cannot be implemented overnight. As strong economic performance continues to escalate power demand, many SSA countries will continue to face a very tight demand-supply balance in the coming years. It is therefore critical that longer-term efforts should redress the underlying structural causes of SSA's current power supply crisis. These endeavors should be complemented by shorter-term measures to soften the economic and social impact of power scarcity. Recent experiences from countries such as Brazil show that well-designed demand-side management measures can go a considerable way towards trimming peak demand, thereby substantially reducing the extent of power rationing at relatively low economic and social cost. A good example of such measures is a quota system with price signals, combined with a public energy-efficiency campaign.

5.0 CONCLUSION AND RECOMMENDATION

The intrinsic link and positive relationship between energy and overcoming poverty – whether income-defined poverty or poverty linked to inequality in income distribution within countries – is very strong in Sub Sahara Africa. It is clearly demonstrated by the fact that poor people constitute the bulk of the estimated 3 billion people primarily relying on solid fuels (coal and traditional biomass) of which 2.7 billion people cook and heat their homes with traditional fuels and low-efficiency stoves (UNDP and WHO, 2009; IEA, 2010a) and almost one and a half a billion without access to electricity (IEA, 2010a).

Without addressing the socio-political issues of energy poverty specifically in the SSA region, African economies would have difficulties taking off at a sufficient pace; first, to achieve the MDGs by 2015; and second, to provide a reasonable quality of life to a population that is projected to double by 2030.

To face this challenge, AfDB will continue to direct its relatively limited resources into energy projects that have the highest impact in terms of the population served. It will continue to support governments, authorities, regional organizations and private entrepreneurs. The Bank will do so by acting as a wise adviser, financier, facilitator and an honest broker in assuring that the availability, accessibility and affordability aspects of the energy supply chain are equitably balanced and respectful of the environment in the proper utilization of resources. With the creative arrangements made under the recently replenished AfDB's 11th Resource Replenishment (ADF XI) for allocating significant resources to regional projects, the Bank will be the key player in partnership with other institutions. It will also collaborate with initiatives like the New Partnership for Africa's Development (NEPAD) and the Infrastructure Consortium for Africa, so as to change the energy map of the continent.

The numerous authorities created at national and regional levels such as the RECs and various other initiatives deployed by sister institutions and NGOs, will receive due attention from the Bank, which will always consider their interventions alongside its own operations.

The AfDB will also encourage and participate maximally in the development of initiatives and actions by the various power pools created in Africa. The Bank will also partner with continental or international actors like the African Energy Commission (AFREC), which launched the African Energy Information System (AIES). By building databases of statistics and information on the African energy sector, the AIES is performing a crucial role. Sound knowledge of the energy sector is now very important for decision makers. This is because it helps them to adopt and implement appropriate policies and strategies in a globalized world, where energy access has become the most important challenge for preserving peace and stability as well as providing support for the socio-economic growth of the less developed regions.

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