WEST AFRICA ENERGY SECURITY REPORT

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This report, intended to be the first in a series, focuses on energy security and its various dimensions as they apply to conditions in West Africa.[1] Understanding energy security is important because the reliable supply of commercial energy services is essential for growing economies in West Africa. As people elsewhere, citizens in West Africa seek a higher standard of living, which is only possible with access to commercially sustainable energy services. Yet, most of the region lack the energy infrastructure needed to meet demand, although resources such as oil, gas, hydro and coal are available and there are opportunities for modern use of biomass and other renewables such as wind and solar. In general, there are three key barriers to expansion of energy services: 1- inadequacy of tariffs to allow companies to generate enough funds to reinvest in new generation facilities and wires to distribute the electricity; 2- weakness of utilities and regulators as key sector institutions; and 3- insufficiency of government investment during this period of crisis and transition. In this report, we provide a snapshot of the current energy situation in the ECOWAS region with a focus on various energy security considerations. We develop some indicators for the countries in the region and offer observations from other countries' strategies to enhance energy security. We also provide updates on key regional projects such as the West African Gas Pipeline and West African Power Pool, and some developments in WAGP countries. During these updates, three barriers to sustaining investment in energy infrastructure are revisited. We hope that this report and its consecutive issues will provide stakeholders in West Africa with an insight into global and regional energy trends and security concerns that will enhance energy policy development in the region that is conducive to increased investment flows.

Why Discuss Energy Security?

In recent years, the price of oil has increased significantly and remained high, supported by geopolitical concerns, strong demand growth in the world and increased levels of speculative trading in futures markets. The prices of natural gas and coal have also increased, albeit to a lesser extent than oil. Global economic growth has spurred demand for these fuels as well. Rising capital costs contributed to higher fuel prices. Electricity generation costs have followed this upward trend. The world economy, which appeared immune to high prices for a long time, started to feel the pain in recent months. Of course, what ails importing countries has been a boon for exporting countries at least in terms of increased revenues, which, based on government policies, has had varying degrees of positive impact on domestic economies.

Historically high energy prices, rising capital costs of energy infrastructure projects, the increasing assertiveness of resource countries, and global environmental risks force countries to devise energy security policies.

Rapidly growing demand for energy over the last decade erased most of the spare capacity in the oil market, leaving Saudi Arabia as the only country that has maintained some spare production capacity. Barriers to investment in oil exploration and development are rising as resource owners seek to increase their control of the industry; they create rules that favor national companies or ask for a larger share of revenues through higher taxes or royalties. Capital costs have also increased mainly due to shortages of

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equipment, material and skilled human resources. The lack of spare capacity increases the risk of even relatively small disruptions in oil supply causing large and sustained price spikes.

This high price environment raises energy security concerns just as the oil price spikes did in the 1970s and early 1980s and brings back memories of economic recession. At that time, most energy importers, especially countries with negligible domestic natural resources, developed various strategies to enhance energy security and have pursued them since. These strategies include upstream investment in producing countries, long-term contracting at premium prices, diversifying fuels and suppliers of each, promoting dual fuel technologies, efficiency and conservation, and building strategic reserves. For example, natural gas use, especially in combined cycle power plants, and its trade in the form of liquefied natural gas (LNG) have expanded greatly as a result of these strategies.

Today, environmental considerations also impact energy security calculations. These concerns encourage development of alternatives such as biofuels or non-carbon generation technologies. In many cases, other security concerns emerge; for example, biofuels raise questions about substitution of land away from food crops, depletion of water resources and deforestation.

Inadequacy of tariffs, nonpayment by customers, weak enforcement of bill collection, administrative inefficiency and the lack of enforcement of laws and contracts are among the top reasons for failure of private investment in electricity sectors in developing countries.

Many private investors, mostly from OECD countries, invested in developing country power sectors since the early 1990s. The global experience with these investments shows that inadequacy of tariffs, nonpayment by customers, weak enforcement of bill collection, administrative inefficiency and the lack of enforcement of laws and contracts can lead to failure of projects.[2] In most countries, both the investors and host governments have learned lessons from these failures. In many countries, domestic private enterprises have started investing in the power sector.

Subsidies for oil products such as diesel, kerosene or LPG are very common around the world. Subsidies not only eat into government budgets but also encourage wasteful use of energy and adulteration of fuels. The increase in the price of oil since 2003 has put many governments in a difficult spot. A recent analysis of 51 developing and emerging market economies underlines the cost of fuel subsidies and the failure to pass through the increasing cost of international oil prices between 2003 and 2006.[3] Many governments pursued similar protective measures in 2007 and 2008 as well, often lowering taxes or paying their state companies the difference between global prices and local prices to keep the end-user prices the same. But recently the burden of subsidies has become unbearable to governments of Indonesia, Malaysia, India and China among others, which reduced fuel subsidies in various degrees. Countries in West Africa are also reducing some of these subsidies. Phasing out of subsidies in the energy sector will help rationalize energy use, reduce value destruction through black market activities and encourage legitimate private investment in supply of these fuels, all of which should contribute to enhancing energy security and economic activity.

Energy price subsidies not only reduce revenue flows to government budgets but also encourage wasteful use of energy and adulteration of fuels, and hence worsen shortages.

[2] For example see What International Investors Look for When Investing in Developing Countries: Results from a Survey of International Investors in the Power Sector, by Ranjit Lamech and Kazim Saeed, Energy and Mining Sector Board Discussion Paper No. 6, 2003.

[3] Domestic Petroleum Product Prices and Subsidies: Recent Developments and Reform Strategies, by Taimur Baig, Amine Mati, David Coady, and Joseph Ntamatungiro, IMF Working Paper No. 07/71, March 2007.

Energy Security Situation in West Africa

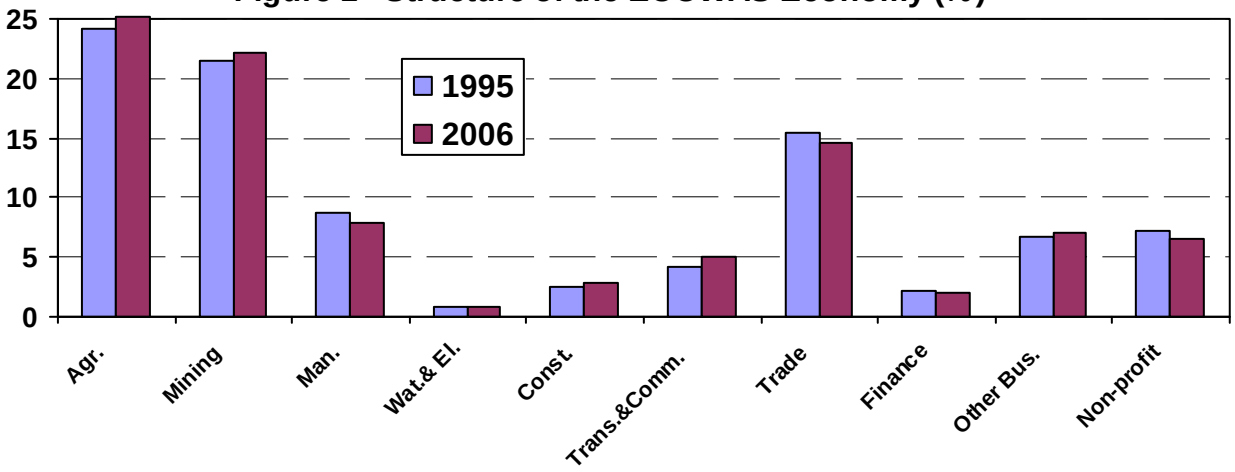
Countries in West Africa face many of the same challenges as the rest of the world: their economies are growing, fueling energy demand. Besides few exceptions such as Nigeria the countries in the region do not have or have not developed sufficient domestic resources so they have become dependent on imports; state companies, which dominate the energy sector, lack commercial incentives and tend to be inefficient; prices for fuels such as kerosene, LPG and diesel, and electricity are heavily subsidized, encouraging inefficient use of energy, deterring additional investment in energy supply, and often resulting in shortages and rationing.

West African Economy

The Economic Community of West African States (ECOWAS) is a regional body of 15 member states. The members are Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Guinea, Guinea Bisau, Ghana, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. The total population of the 15 countries in 2005 stood at about 262 million representing 40% of the total population of Sub-Saharan Africa. Three of the member countries, Nigeria, Ghana and Côte d'Ivoire accounts for two-thirds of the population of the sub-region. The population growth rate of the sub-region, estimated at 2.65% per annum is the highest in the world. With this growth rate, the population of ECOWAS is projected to rise to 320 million by 2015. Currently 43% of the population resides in the urban areas. This is projected to increase to 50% by 2015.

A key feature of the sub-region is the uneven distribution of region's natural resources among the countries in the region. While ECOWAS is well-endowed with natural resources in per capita terms, these resources are in fact, highly concentrated in certain countries and, in many cases, little exploited. Nigeria for instance has almost all of the region's proven crude oil, natural gas and coal reserves; but only crude oil reserves have been tapped in a significant way while coal reserves mostly lay dormant. Similarly 65% of the region's hydro-electricity potentials are located in Nigeria and Guinea. The same pattern holds for other minerals. Liberia and Sierra Leone possess the highest iron deposits, Ghana the lion share of gold, Ghana and Sierra Leone dominate diamond reserves.

Figure 1 - Structure of the ECOWAS Economy (%)



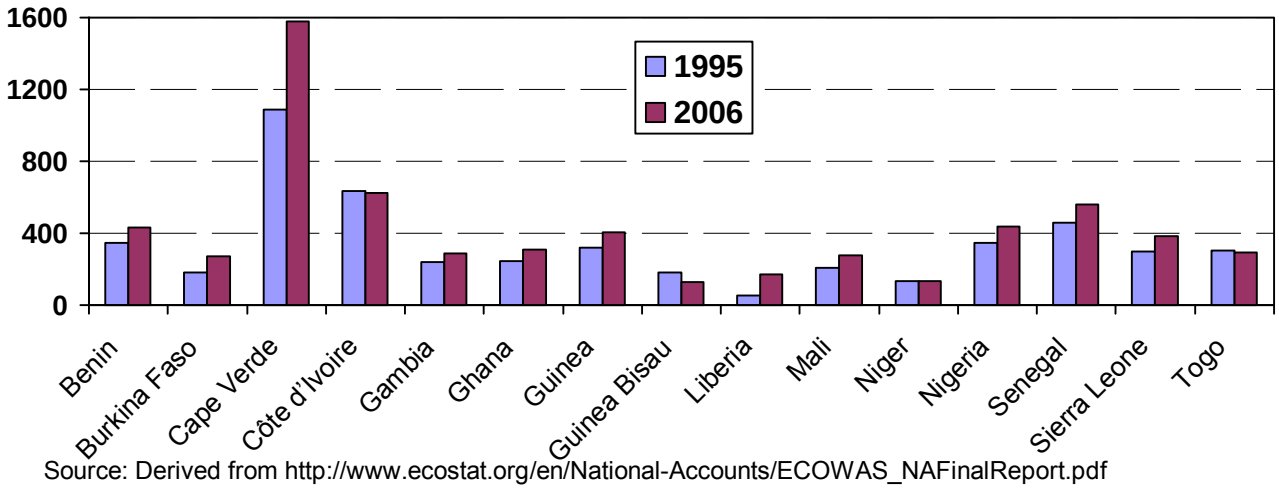
Source: Derived from http://www.ecostat.org/en/National-Accounts/ECOWAS_NAFinalReport.pdf

West Africa Socio Economic Context

The agricultural sector with 25% and the mining and quarrying activities with 22% dominate the economies of the region. With a share of 15%, trade is also very important. Figure 1 shows the structure of the economies, which has not changed fundamentally since the mid 1990s.

Poverty is widespread in ECOWAS. Per capita incomes in all of the countries, with the exception of Cape Verde, fall in the category of Less Developed Countries (Figure 2). Human Development Indicators are generally very low in nearly all of the countries. Poverty rate is estimated at 44% in the ECOWAS region. Three of the countries – Nigeria (55.6%), Ghana (6.9%) and Côte d'Ivoire (10.7%) account for over 70% of the total GDP of the sub-region. HIV/AIDS is also endemic. Other socio-economic indicators such as literacy rate, maternal mortality rate, access to safe water, among others are also relatively lower in the region compared to other developing regions of the world.

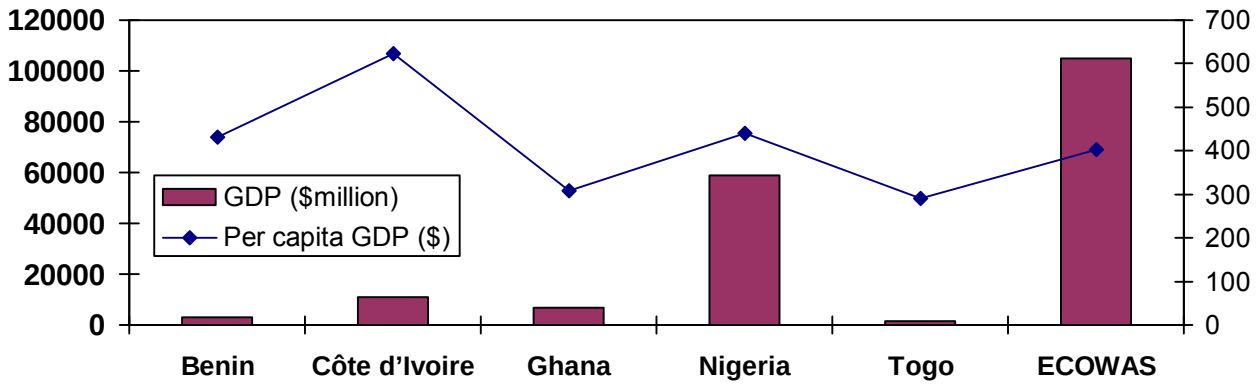
Figure 2 - Per capita GDP in ECOWAS (2001 dollars)



Source: Derived from http://www.ecostat.org/en/National-Accounts/ECOWAS_NAFinalReport.pdf

In the rest of this report, we will focus on Nigeria, Ghana, Côte d'Ivoire, Benin and Togo, primarily due to data constraints but also because, these countries are central to two major regional energy infrastructure projects, the West African Gas Pipeline (WAGP) and the West African Power Pool (WAPP). These countries as shown in Figure 3 jointly account for about 78% of the GDP of the region as of 2006. All of them, with the exception of Côte d'Ivoire are connected to the WAGP. Based on the original agreement, the pipeline can be extended to Côte D'Ivoire.

Figure 3 - GDP & GDP per capita (2001 dollars)



Source: Derived from http://www.ecostat.org/en/National-Accounts/ECOWAS_NAFinalReport.pdf

A Broad Overview of the Energy Sector in ECOWAS

Energy has profound impact on socio-economic development. Most ECOWAS member states have some of the lowest levels of per capita energy consumption in the world. On average ECOWAS countries consume 88 kWh of electricity per person each year compared to 250 kWh in East Asia, for example. In further contrast, the world average is roughly 2,400 kWh per person. The low level of consumption is compounded by very inefficient modes of consumption.

The energy sector in the region has several common features. These include low access to electricity in both the rural areas and urban centres, but predominantly in the former. There is also low access rate to modern fuels in rural areas. It is estimated that biomass accounts for more than 80% of total energy consumption, mainly for domestic purposes such as cooking. The share of biomass among ECOWAS states vary from 22% in Cape Verde to 94% in Liberia. Other countries with figures in excess of the regional average are Burkina Faso (91%), Nigeria (83%) and Sierra Leone (81%).

BIOMASS DILEMMA

The average share of biomass in energy consumption mix of ECOWAS countries was estimated at 80% in 2005. Indeed biomass will for a long time to come remain important in many countries in the region. Not only is the resource a major source of energy but it is also a major source of employment and income and helps conserve foreign exchange by reducing the need for imports. Unfortunately, this important energy resource is fast disappearing as a result of deforestation, which causes a myriad of other environmental and social problems. It is imperative that commercial energy services replace unsustainable use of biomass. We focus on commercial energy in this report but in future issues of this report, we will provide more details on the use of biomass and its various impacts in West African citizens and economies.

This practice has harmful effects on human health, especially if biomass is burned indoors in open pits; and result in degradation of the environment such as deforestation and loss of topsoil, which can have devastating effects on agricultural productivity. In a region where farming is not fully mechanized and provides a quarter of economic output, the health of farm workers and the quality of soil are crucial to the health of the economy. One possible alternative to biomass is liquid petroleum gas, or LPG, that can be distributed in canisters and used in relatively simple and cheap stoves for household purposes. Yet, access to LPG is lower than 5% in all ECOWAS. The only exception is Senegal, where the government deliberately promoted the use of LPG; but consumption is far more predominant in the urban areas, while rural areas remain dependent on biomass. Other

programs focus on improved production and utilization of biomass, using more efficient and modern equipment.

Primary Energy

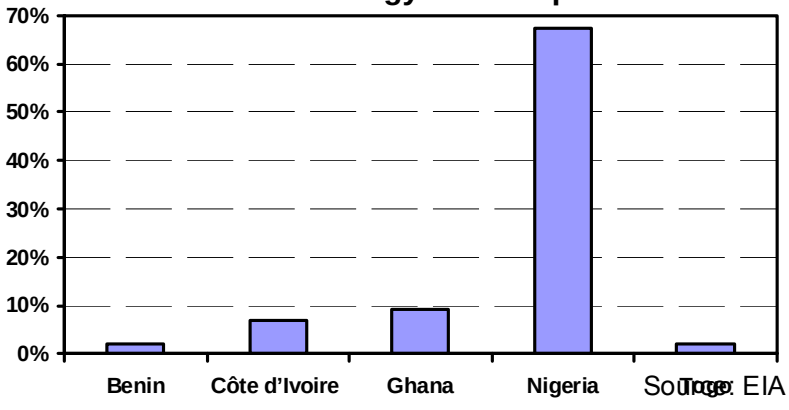
Energy Consumption Mix

Although biomass dominates primary energy consumption in West Africa, the data on biomass use is poor and inconsistent across countries. Also, it should be clear that transition to commercially sustainable, cleaner alternatives to current uses of biomass is necessary for achieving socioeconomic development goals of the region. Today, in the developed world, biomass (in the form of waste products such as agricultural residues and landfills) is still used but at much smaller percentages of total energy needs and in industrial facilities subject to environmental regulations. ***Hence, from now on, we will focus only on commercial energy services, excluding biomass***. This focus should allow us better identify the gap between where our selected countries are in terms of commercial energy consumption and where they desire to be in order to raise the standard of living of their citizens. In order to maintain data consistency, we use 2005 data obtained from several sources, including the World Bank, World Development Report, U.S. Department of Energy, U.S. Energy Information Administration, and country and other regional sources.

Nigeria consumes about two thirds of energy in the ECOWAS region.

Among the selected ECOWAS states, total energy consumption in 2005 varied from 0.034 quadrillion British thermal units (Btu) in Benin to 1.068 quadrillion Btu in Nigeria. Figures for other countries are: Ghana 0.149, Togo 0.036 and Côte d'Ivoire 0.113 quadrillion Btu. Respective figures for Africa and the World are 14.35 and 442.31 quadrillion Btu. Figure 4 shows the share of energy consumption of the five countries in total energy consumption in the ECOWAS region. Nigeria, as the largest country and the largest economy in the region, has the lion's share of total energy consumption in the ECOWAS region accounting for more than two thirds of total consumption. Other countries' shares are much smaller: Ghana accounts for just over 9%, followed by Côte d'Ivoire with about 7%. Togo and Benin record little over 2% each. In all, the five countries account jointly for 87% of total energy consumption in the ECOWAS region.

Figure 4 - Share of selected countries in ECOWAS energy consumption

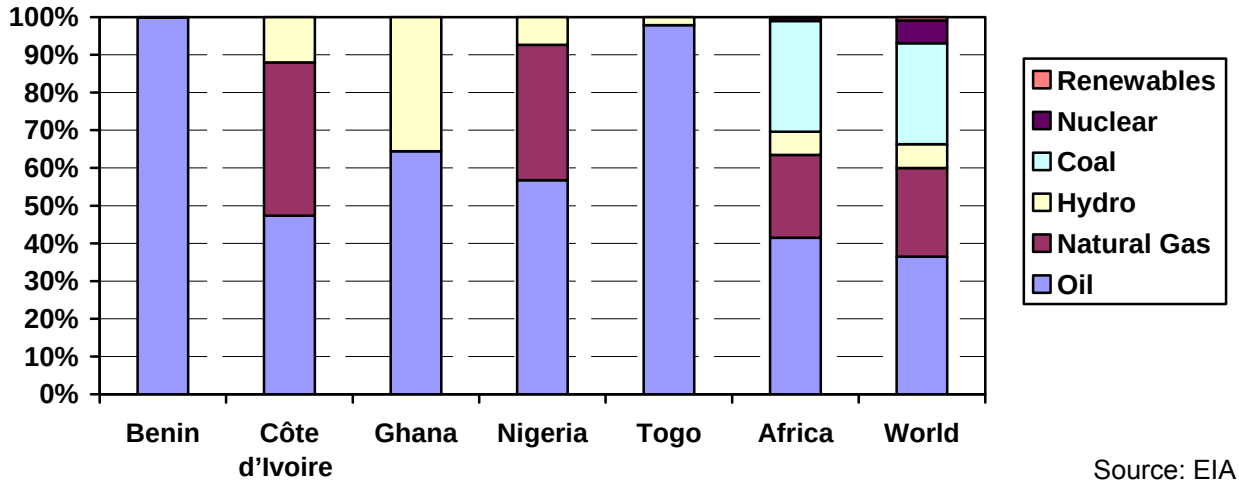


Source: EIA

Diversification of energy sources, in terms of both types of resources and sources of supply for each type, is the most important criterion for enhancing energy security. In Figure 5, the commercial energy consumption mix of the selected countries is depicted. Clearly, there is not much diversification of energy sources. For instance, Benin totally and Togo almost totally depend on oil, which is also important for other countries but somewhat less so. Ghana has basically two sources of energy: oil and hydro. In 2005, the share of oil was 64% but in 2006 and 2007, due to low water levels in Akosombo dam, the share of oil might have increased as Ghana needed more oil to

generate electric power to compensate for lost hydroelectricity output. In addition to oil, Nigeria and Côte d'Ivoire also have natural gas production and have been able to diversify more than the others in the region, but still they are basically two-fuel economies. Oil and natural gas account for 57% and 36% in Nigeria, and 47% and 41% in Côte d'Ivoire. The use of coal and commercial renewables is negligible in all countries under consideration; there is no nuclear facility in the region.

Figure 5 - Commercial Energy Consumption Mix, 2005



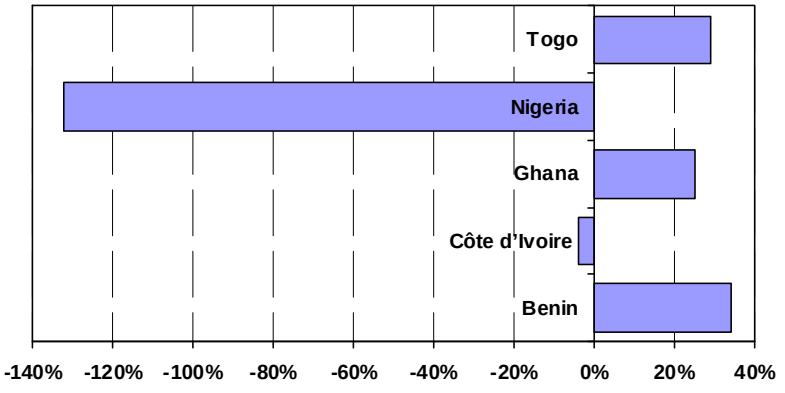
Source: EIA

There is limited diversification of energy sources; countries depend basically on oil and natural gas. Hydro plays an important role in Ghana but can be unpredictable. Benin, Ghana and Togo are dependent on imported oil.

Energy Imports/Exports

Dependence on imported energy is often treated as a risk to energy security, especially if the imported fuel is crucial for the economy and if imports come from a small number of sources. Here, energy imports are estimated as energy use less production. In Figure 6, the share of imports to total consumption is reported; ***the data source includes biomass***. A negative value indicates that the country is a net exporter. Nigeria and Côte d'Ivoire export more energy than they consume, while the other countries are net importers of their energy needs with relatively little energy resources of their own. For instance, Ghana imports about 25% of its energy consumption, while Togo meets 28% and Benin about a third of their energy needs from imports. Clearly, if it were not for biomass consumption included in the data, the import dependence of Benin and Togo would be 100% as

Figure 6 - Share of net imports, 2004



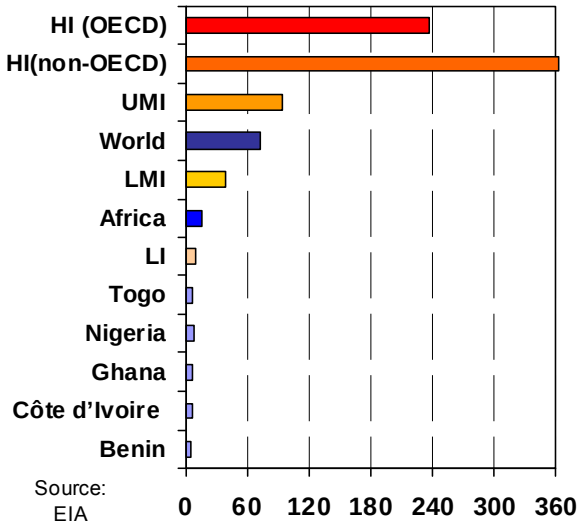
Source: World Development Indicators, 2007

they import all of their oil, and Ghana's dependence would also be higher as the country imports almost all of the oil it consumes, which is more than 60% according to commercial energy data used in Figure 5. Due to its oil exports, Côte d'Ivoire becomes a net exporter of energy, producing about 4% more energy than the country needs. Nigeria is a major producer and exporter of oil; the country also exports natural gas in the form of liquefied natural gas, or LNG, and through the West African Gas Pipeline (WAGP). Overall, the country exports more than twice as much energy as it consumes. If we were to exclude biomass data, Nigeria and Côte d'Ivoire would have shown as larger exporters of energy.

Energy Consumption

That there is a direct relationship between energy consumption and economic output is an established fact. One does not need to look at statistics to believe this statement as we can observe the difference in the standards of living in developed countries versus those in developing countries, and also within each society. More industrial activity, more traveling for business and pleasure, moving into bigger houses, cooling and heating work and living spaces, increasing use of electronics and similar activities all boost the use of energy as they improve people's standard of living and raise economic production. As such, per capita consumption of energy is a good first-level indicator of the average standard of living.

Figure 7 - Annual consumption per capita, 2005



Source: EIA

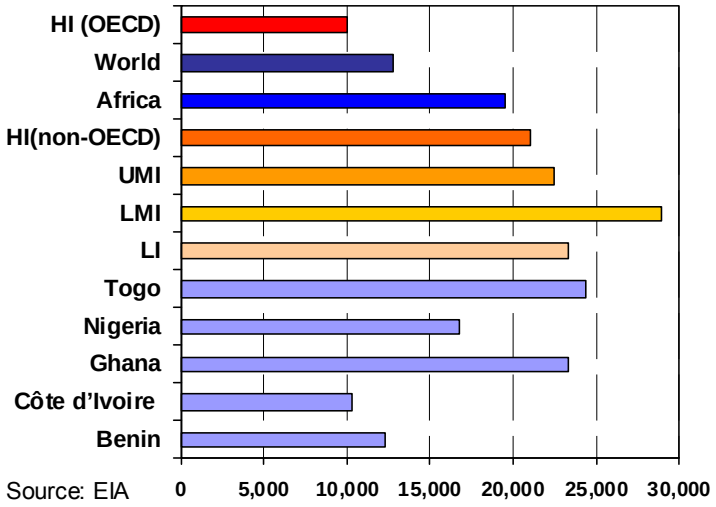
Annual per capita energy consumption in five West African countries is depicted in Figure 7 in comparison with those for Africa and the world average. Income classification of the World Bank is used: low income (LI), lower middle income (LMI), upper middle income (UMI) and high income (HI). High income countries are further divided into OECD and non-OECD countries as, generally speaking, OECD economies tend to be more services oriented and less resource industry dependent than non-OECD high income countries – note that per capita consumption in HI(non-OECD) is 50% larger than that in HI(OECD).

An average citizen of Africa consumes less than a quarter of the energy consumed by an average citizen of the world and an average citizen in West Africa consumes less than half of what an average African consumes.

An average citizen of Africa consumes about 16.1 MMBtus, which is less than a quarter of what an average citizen of the world consumes, about 71.8 MMBtus. In all of the selected West African countries, citizens consume much less than these numbers. An average Nigerian consumes about 8.3 MMBtus, about half of the consumption of the average citizen in Africa, followed by Ghana, with about 6.8 MMBtus, and Togo and Côte d'Ivoire, with 6.6 MMBtus. Residents of Benin consume only 4.5 MMBtus. These numbers are significantly below the world average, underlining the significant lack of access to commercial energy services, which is a key reason for slow and sporadic economic growth in the region.

Energy intensity, that is, how much energy is used to produce economic output worth a dollar, is another useful indicator providing insights into the stage of economic development as well as efficiency and nature of energy use. The historical pattern has been for economies to develop through a path of industrialization and to become more services oriented once a certain level of income is reached. Along this path, the amount of energy an economy consumes in order to generate a dollar of economic output (that is, energy intensity) rises as the country transitions from an agricultural base to an industrial phase. Later on, transition from an industrial base to services reduces energy intensity. Statistics reported for various income groups in Figure 8 (economic output is measured in gross domestic product, or GDP) are consistent with these historical observations: the energy intensity increases while moving from the LI group to the LMI group but it then decreases as income levels continue to rise. The lowest energy intensity is achieved by the OECD countries, presumably the most developed countries with highest average income. Clearly, most of Africa and West Africa in particular, are in low income category with low levels of industrialization and high share of agriculture as seen before. The energy intensity figures mostly reflect this stage of development. African energy intensity amounted to about 19,529 Btus and except for Ghana and Togo, the energy intensity of the selected West African countries is below the level of Africa. The energy intensity of Nigeria is 16,716, while Ghana, Togo, and Benin and Côte d'Ivoire record 23,338, 24,346, 12,347 and 10,322 respectively.

Figure 8 - Energy intensity (Btu per $GDP), 2005



Source: EIA

General energy inefficiency of the industrial sector; old capital stock in transport, industry and residential sectors as well as office air conditioning systems in major cities contribute to high energy intensity in the region.

These statistics do not include biomass consumption, which, by all accounts, is immense in the region. The addition of biomass to energy consumption numbers would inflate both per capita energy consumption and energy intensity figures. But, there is another uncertainty: the size of the unofficial economy in the region. The same way we do not have confidence in biomass data where it exists, we are also uncertain about the size of the unofficial economy in these countries. Without data on both biomass consumption and economic output in the non-recorded segment of the economy, we cannot be certain how energy intensity numbers could change. But, it is probably a safe bet that biomass consumption constitutes a much bigger share of total energy consumption (earlier, an estimate of 80% was provided for ECOWAS) than the share of unofficial economy as we know that traditional use of biomass is very inefficient (for example, time-consuming to gather and wasteful of energy content when burned in open pits). Hence, energy intensity figures for West African nations are probably larger than those reported in Figure 8. One of the reasons for the dependency on biomass is the low purchasing power of

citizens of the regions which limits their capacity to afford relatively more expensive modern fuels. ***But the poor quality and unreliable supply of existing commercial energy services also force consumers to seek alternatives, including biomass but also expensive options such as diesel generators. Available evidence shows that many people in the region are prepared to pay higher prices for energy services if reliable supply is guaranteed.***

ACCRA, Ghana -- Henry Kobby, 22, opened his family's store here, which sells drinks and food, 18 months ago. But what seemed like a viable business idea in early 2006 is now undermined by power shortages that occur at least 24 hours of every three days. When the power goes, so does the refrigerator Kobby needs to keep the drinks cold and the microwave he uses to warm up the pies and pastries.
A similar fate has befallen many businesses. Some cybercafes do not bother to open their doors when there is no electricity. Barber shops and salons might be open, but scissors-only haircuts are not in high demand. The neighborhood pharmacy, having its refrigerators and lights rendered temporarily useless, serves a trickle of clients by candlelight.
The fortunate can afford diesel-fueled generators, their hum now a permanent part of Accra's soundscape. They allow businesses to function normally when the power is off, but they are expensive to run, given high fuel prices, and fallible. Generators cannot only blow appliances, they can break down -- as a reporter experienced at a popular restaurant and Internet cafe -- if they are not well maintained.
http://www.worldpoliticsreview.com/Article.aspx?id=957

Electricity in West Africa

Access to centrally provided commercial electricity service is very limited in West Africa although many use diesel-fueled generators to meet their electricity needs. In Ghana, 50-60 % of the population is said to have access to grid electricity. Benin, Senegal, Côte d'Ivoire have an overall electricity access rate ranging from 20 to 40%. In other ECOWAS countries, the access rates are lower. There are considerable service access gaps among urban zones (40%) and rural areas (average 6-8%). There is also inequality in access by income levels.

Esther, 32, has a shop at the Student Union Block (SUB) business centre, University of Ibadan, Nigeria. University of Ibadan founded in 1948 is the oldest university in Nigeria. However, in the early part of 2008, electricity supply has averaged two hours a day. Electricity outages are of longer duration and unpredictable. Esther sells soft drinks of all kinds. She opened this business 4 years ago. The business seemed viable and promising, but the story has changed as a result of power shortages. The epileptic power supply reduced her sales and consequently her revenues. She used to sell 10 crates per day, but now she hardly sells three crates, because most of her customers demand cold drinks.
Other businesses are also suffering. For instance, Afolabi, a data analyst, has a business centre at the SUB. Recently he had to buy a bigger generator to augment the irregular supply of electricity, increasing his costs. In fact, sometimes he does not bother to open his shop due to increase in the cost of fuel and other running expenses. Electricity shortages caused most of his customers not to patronize him as regularly as before, reducing his income. Likewise, most cybercafés, barber shops and restaurants stopped opening their shops when there is no electricity supply as they cannot afford diesel-fueled generators. Their businesses only function normally when the power is on.

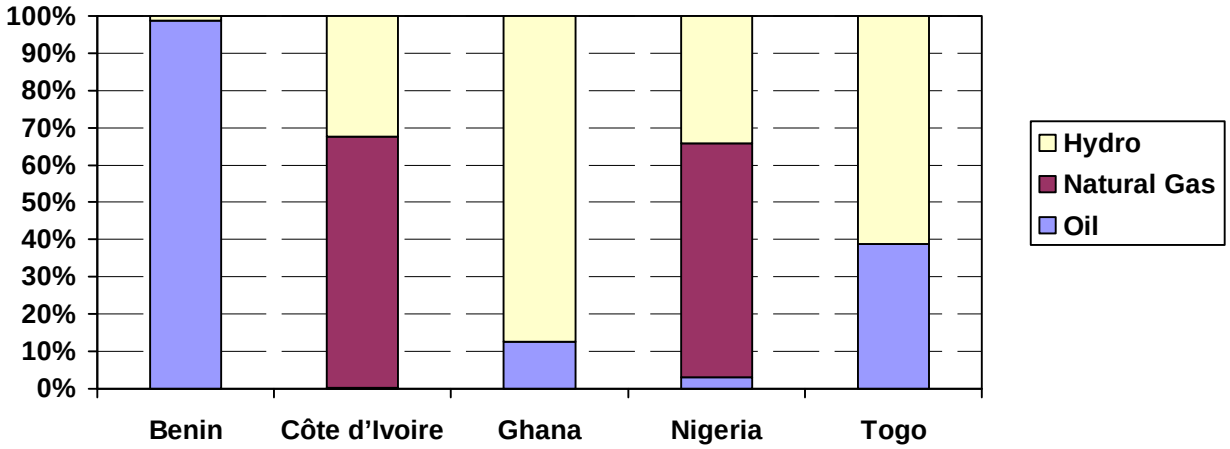
Since mid 2006, West Africa has been facing a serious shortage of electricity; growing economies in the region fueled demand for electricity but necessary investments in new generation capacity as well as transmission and distribution networks did not take place. Efforts to diversify the generation fuel portfolio and to increase grid reliability faced challenges as regional projects such as the West African Gas Pipeline (WAGP) and West African Power Pool (WAPP) faltered when the construction of the pipeline and gas supplies were delayed. Low levels of water in dams such as Akosombo in Ghana and problems in supplying gas to power plants in Nigeria further curtailed the already short generation capacity in the region. ***Resulting increased reliance on oil or diesel (imported in the case of all countries in the region including Nigeria) combined with historically high oil prices hurt government budgets and current accounts.*** Many businesses were shut down or saw lost sales due to blackouts (see boxes for examples of costs of power cuts). A look at the electricity infrastructure in the region is useful for identifying issues that need to be addressed.

Installed Generation Capacity

Electricity generation is dominated by one source in most countries, especially in Benin and Ghana (Figure 9). Currently, Benin generates all of its power from oil-fired facilities while Ghana

depends on hydropower for most of its electricity. In Togo hydro also plays a significant role in electricity generation. Ghana built the Takoradi plant to diversify away from hydro. The plant will eventually run on natural gas but has been using oil until gas flows from the West African Gas Pipeline is increased. In the last couple of years, Ghana had to rely more on this thermal facility and diesel generators burning imported oil and products due to low levels of water in the Akosombo dam. All three countries are counting on natural gas to be delivered from the WAGP to diversify their generation portfolios and reduce reliance on imported oil, the price of which has spiked recently. In Nigeria, meanwhile, natural gas plays a more dominant role accounting for about 62% of the electricity generation capacity. The case in Côte d'Ivoire is similar, about 67% of its electricity generation from natural gas, while hydro accounts for about 33%.

Figure 9 - Installed Generation Capacity, 2005



Source: World Development Indicators, 2007.

However, in all of the countries, two inputs account for over 95% of total generation capacity. This high concentration provides little energy security for the country as the disruptions in one or both of these sources have significant impact on electricity generations in these countries. ***Given that one of the resources is water; seasonal fluctuations and unexpected weather patterns increase the risk to the availability of electricity on a consistent basis.*** The risks are compounded by limited electricity trade among the countries presently. The lack of trading is also as a result of limited excess capacity in individual countries that could be traded across the borders. In Nigeria, the problems in the Niger Delta have often affected the supply of gas to the power stations leading to major disruptions in electricity generations. Low levels of water in the hydro stations at times co-exist with the gas disruptions creating blackout in most parts of the country. As a result, other longer term alternatives such as importing liquefied natural gas (LNG) or coal, or developing regional coal reserves, or modern biomass applications are under consideration.

System Losses

There are significant technical and non technical losses in most West African countries. For instance, reported losses for Togo and Nigeria are about 34% compared to 5-8% in developed countries (Table 1). For countries that have not been able to meet their electricity generation requirements, such massive losses are a reflection of poor management of the grid, weak planning capacity, and technical and economic inefficiencies. Ghana and Côte d'Ivoire have lower losses compared to Nigeria and Togo with 14.7% and 16.7% respectively but still

high relative to best practices. By many accounts, reported losses are less than actual losses. Net imports in all the countries considered are negligible.

Table 1 – Electricity in West Africa, 2005

	Benin	C. d'Ivoire	Ghana	Nigeria	Togo
Annual Consumption per Capita (kWh)	66	176	247	104	87
System Losses (%)	-	16.7%	14.7%	33.7%	34%
Net Imports (% of cons)	100%	-48%	3%	Neg.	84%

Source: World Development Indicators and EIA

Ghana records the highest annual consumption per capita (kWh) of 247 kWh followed by Côte d'Ivoire which has 176 kWh per capita. Meanwhile, Nigeria, Togo and Benin record 104 kWh, 87 kWh and 66 kWh respectively. In other words, electricity consumption per capita is below the UN specified minimum energy required for subsistence development of 500 kWh; much less than the 1,000 kWh required for industrialization take-off; and far below the world average of about 2,400 kWh.

Regional Electricity Trade and the West African Power Pool (WAPP)

The ECOWAS region is characterized by significant power supply and demand imbalances, abundant but unevenly distributed energy resources within the region as well as weak infrastructure base for energy trading. Hence, all of these provide a basis for coordination among the countries as the region as well as offer prospect for trading across the countries in the region. The West African Power Pool (WAPP) was set up to address these issues. ECOWAS adopted in 1999 the principle setting up the WAPP system. In specific terms ECOWAS Vision with respect to the power sector are to:

Current WAPP priority projects
330-kV Interconnection line Ikeja West (Nigeria) – Sakete (Benin)
255-kV Bobo Dioulasso – Ouagadogou Transmission Line (Burkina Faso)
330-kV Volta – Monne Hagou-Sakete (Ghana – Togo – Benin Interconnection)
330-kV WAPP Northcore Line: Birnin Kebbi – Bemberke – Niamey – Ouagadogou
OMVS – SOGEM felou 60-MW Hydro Project
OMVG Project
225-kV Bolgatanga – Ouadgogou Line (Ghana – B.Faso Interconnection)
Han-Bobo Dioulasso – Sikasso – Bamako line (Ghana- Burkina Faso – Mali)

(a) develop interconnection and power exchanges between member states
(b) harmonize legislation and standards for power sector operations
(c) promote and protect private investment in energy projects
(d) use flare-gas in Nigeria to feed power stations in neighbouring countries
(e) create an open and competitive regional electricity market.

The objective of WAPP is to interconnect national grids across 5,600 km in most West African countries (Nigeria, Benin, Togo, Ghana, Côte d'Ivoire, Niger, Burkina Faso and Mali). WAPP seeks to improve supply of reliable, stable, sustainable and affordable electricity. It also seeks to develop integrated regional electricity market that can enhance reliability and lower cost of electricity across the region. ***Total investment in the WAPP infrastructure will amount to about US$18 billion between 2004 and 2020. About 90% of this investment is needed for building new generation capacity.*** WAPP seeks to develop both hydro and thermal generation projects across the region as well as invest in transmission and distribution infrastructures. The ECOWAS Energy Protocol was modeled on the European Energy Charter.

WAPP Development Issues - scorecard

- WAPP Operations Manual is developed
- A draft methodology on WAPP transmission tariff has been developed
- ECOWAS Regional Electricity Sector Regulatory Authority is proposed
- Many feasibility studies are underway
- Funds raised from various sources
  - KEPCO is working on Information and Coordination Center
- There are delays in financing some projects

The progress on technical aspects of WAPP has been good and some investment has taken place to enhance transmission capacity and establish the Information and Coordination Center. However, the delays in gas flows from WAGP and the general crisis conditions in the region's energy sector hamper the ability to raise necessary funds to meet all planned investment needs according to the timetable. Without the expansion of generation capacity around the region, the WAPP grid will not provide the relief the region needs.

Electricity in Nigeria

The Nigerian power sector operates well below its estimated capacity, with power outages being a frequent occurrence. According to the Power Holding Company of Nigeria (PHCN), the country's peak electric demand in February 2006 was 7,600 megawatts (MW), but actual generation capability was 3,600 MW. The discrepancy between electricity demand and actual generation is mostly due to low water levels, insufficient gas supply, inadequate plant maintenance and old equipments. During 2005, electricity generation capacity fluctuated between 2,600 MW and 3,600 MW. And earlier this year (2008), electricity generation capacity actually fell under 1,000 MW. The hydropower stations Kainji, Jebba, and Shiroro have seen generation affected by insufficient water, and the Lagos Egbin, Delta, and Port Harcourt Afam plants are also operating at below capacity due to poor maintenance and inadequate gas supply. Electricity access among Nigerians is only 40%, mainly in urban areas.

Electricity in Ghana

Hydroelectricity is the primary source of Ghana's power. Ghana's current hydroelectric capacity of 1.2 GW is located at Akosombo (912 MW) and Kpong (160 MW). There is 550 MW of thermal capacity in Takoradi and more thermal capacity is planned for Tema pending the flow of sufficient gas from WAGP. In 2005, the turbines of the Akosombo generation station underwent retrofitting to increase its installed capacity by about 108 MW. The Ghanaian government is considering additional hydroelectric projects to be built on a Build Operate Transfer (BOT) financing scheme. One of these proposed projects is the $700-million Bui hydroelectric project, which would be located on the Black Volta and have a generation capacity of 400 MW. In addition to increasing the domestic electricity supply, power generated from Bui could be exported to Burkina Faso, Mali and Côte d'Ivoire. Additional hydroelectric projects include the Hemang and Juale hydroelectric power dams (expected to be operational by 2015) and the Pwalugu hydroelectric power dam (expected to be operational by 2020). The generation capacity of Hemang, Juale and Pwalugu would be developed to 93 MW, 87 MW, and 48 MW respectively.

Electricity in Côte d'Ivoire

Côte d'Ivoire's natural gas-powered stations generate more than half of the country's annual production. In 1995, Côte d'Ivoire built her first natural gas-fired plant, Vridi II, near Abidjan. In

1999, the 288-MW Azito power station came online. Azito produces more than a third of the country's power. The phased construction of a third turbine in Azito has been delayed pending a satisfactory rise in domestic and regional demand for electricity, through the West African Power Pool (WAPP). In May 2005, Alstom signed a 10-year service contract for the Azito plant. In addition to natural gas-powered stations, Côte d'Ivoire also uses hydroelectric plants to generate electricity. Although they no longer run at full capacity, hydroelectric plants (Ayame I and II, Kossou, Taabo, Buyo and Grah) continue to generate about 17% of the country's electricity. Ivoirians also use individual fuel-powered generators in most part of the country as the case is in most of the West African countries.

Investment Challenges

Fundamentally, the issue facing the West African power sector is one of attracting investment in the energy infrastructure. Although WAPP has been successful in attracting investors for some of the transmission projects, there is still a large need of investment, especially in generation capacity around the region. ***The service quality has been poor with frequent outages, which encourages alternatives such as self-generation and theft of electricity. Under these conditions, it is difficult to address one of the key concerns for many investors: inadequacy of electricity prices, or tariffs.***

As regulatory agencies, tasked and empowered to set tariffs, implement gradual increases in tariffs to make them high enough to allow cost recovery, they need the support of governments and work hand in hand with the utilities to improve service quality so that the customers will see the advantage of paying their bills regularly.

The government support should emphasize an effective communication with the consumers but may also include policing to prevent and punish theft of electricity and non-payment of bills. State utilities need to recover their costs as well; so they need tariffs high enough for them to generate funds for new investments and maintenance of existing infrastructure. They may benefit from corporatization and recapitalization.

For some infrastructure such as major transmission lines, initial government funding may be necessary and such an investment is preferable to price subsidies as a better way of using government funds. A similar situation exists in Nigeria in developing the natural gas infrastructure necessary to bring flared gas into the market. If the natural gas pricing proposed under the Gas Master Plan does not offer sufficient incentives for investment to take place, either that pricing needs to be fixed or a one-time infrastructure investment by using state funds, erhaps through a public-private partnership arrangement, is needed (see below the Natural Gas section for further discussion).

Self-generation is already common in the region but more efficient forms of self-generation can be encouraged by allowing access to the grid and direct sale to users or a wholesale market. When generation investments are evaluated, it is useful to look at long-term cost of electricity different options may offer (Table 2), while also pursuing a diversification strategy to enhance energy security. Although currently not used in West Africa, the cost advantage of coal makes this resource a viable option to consider. The global coal trade has been increasing despite concerns about climate change due to relative abundance of coal resources around the world. The nations in West Africa can take part in this growing global market or pursue domestic coal development where resources exist. The global LNG trade is also growing but this market is more competitive than that for coal. Individual countries in West Africa cannot absorb the LNG volumes that would secure cargoes for them but a regional approach can be considered, where a large power plant integrated with an LNG import terminal can feed into the WAPP to provide electricity to the region. Although relatively more expensive, smaller scale renewable projects

can be relevant for rural applications, especially if they help avoid expensive investment in transmission and distribution lines.

Table 2 - Levelized Costs of Different Generation Technologies at 10% discount*

Coal	Natural Gas	Nuclear	Wind	Micro Hydro	Solar	CHP
$35-60 per MWh Inv 50% O&M 15% Fuel 35%	$40-63 per MWh Inv 20% O&M 7% Fuel 73%	$30-50 per MWh Inv 70% O&M 20% Fuel 10%	$45-140 per MWh O&M 13-40%	$65-100 per MWh	$200 (24% availability)	$30-70 per MWh

Source: *Projected Costs of Generating Electricity -- 2005 Update*, by the International Energy Agency and Nuclear Energy Agency.

* Since the 2005 report, power plant construction costs have increased significantly, more than doubling in some areas. Natural gas and coal prices have also risen (the table is based on natural gas prices of $3.5-4.5 per million British thermal unit, or MMBtu). Accordingly, levelized costs, especially for coal and natural gas plants, should be inflated by at least 50%.

Oil in West Africa

Although Côte d'Ivoire has some oil reserves and production, they are very small as percentage of the world's proven reserves at this time. Only Nigeria has sizeable proven reserves, accounting for about 3% of the world's total reserves (Table 3). Recent discoveries in Ghana and increased exploration activity in the Gulf of Guinea may lead to an increase in proven reserves of many countries in the region if necessary legal and regulatory frameworks can be implemented to attract capital investment and experienced upstream companies.

Table 3 – Oil in West Africa

	Nigeria	Ghana	Togo	Benin	C. d'Ivoire
Reserves (% of world)	3%	0	0	0	0
Oil Production (% of world)	3.2%	neg.	0	0	0.14%
R/P (years)	42	7	0	0	4
Net imports (% of cons.)	-682%	88%	100%	100%	-287%
Refining (% of world)	0.6	neg.	0	0	neg.
***Refining (% of cons.)**	162%	91%	0	0	247%

Source: Energy Information Administration

Currently, only Nigeria produces significant amounts of oil, accounting for 3.2% of the world total. Côte d'Ivoire production is equivalent to less than 0.2% of world total but this is more than sufficient for meeting current domestic demand; Côte d'Ivoire is a net exporter of oil, sending to the world almost three times as much oil as it consumes domestically. Both Togo and Benin have no oil production and fully depend on importation of oil. Current production in Ghana is small; the country depends on oil imports for about 88% of its oil consumption. The share of imports has been increasing in recent years as more oil has been needed for power generation. When production starts from recent discoveries in Ghana, the country may become a net exporter of oil by mid-2010s if the fields prove as prolific as predicted.

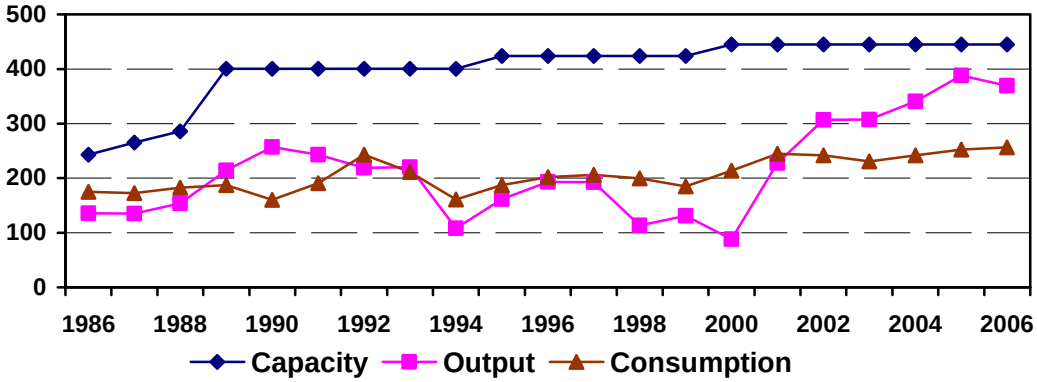
There is significant refining capacity in the region, more than domestic consumption of petroleum products in Nigeria and Côte D'Ivoire. Especially in Nigeria there are several refineries but they all face many challenges. Other ECOWAS refineries are located in Côte d'Ivoire (Abidjan, 65,200 bbl/d); Ghana (Tema, 45,000 bbl/d); Liberia (Monrovia, 15,000 bbl/d); Senegal (Dakar, 27,000 bbl/d) and Sierra Leone (Freetown, 10,000 bbl/d). The construction of a new refinery of 60,000 bbl/d in Abidjan has started in 2008. There are no refineries in Benin and

Togo. Despite the relatively large refining capacity, all the countries are net importers of refined products. These refineries are small by world standards; as such they cannot maximize benefits of economies of scale. At the same time, they are run mostly inefficiently with capacity utilization as low as 70%. Below cost pricing of products do not provide incentives to increase efficiency or maintain facilities. The Tema Oil Refinery may be an exception to these general observations as Ghana has moved to rational pricing of petroleum products over the years but the following discussion on Nigerian refining sector is more representative of the refining sector in West Africa.

While Nigeria's nominal refinery capacity exceeds domestic consumption, its four refineries have been bedeviled by low capacity utilization leaving the country to import most of its refined products (Figure 10). The price subsidy on petroleum products in Nigeria also fuels large scale smuggling of petroleum products to the neighboring countries, ensuring that the country effectively subsidizes consumptions in these neighboring countries. There have also been frequent fuel shortages in Nigeria, culminating in long queues for petroleum at fuel stations. Black market in refined products also thrives in Nigeria and most of the time citizens have to purchase the artificially regulated products in the black market at much higher prices than the official prices.

The gap between refinery capacity and refinery output in Nigeria is a reflection of the poor state of domestic refineries. The performance of the Crude Distillation Units (CDU) and fluid Catalytic Cracking Unit (FCC) remains poor and well below international standards. The refineries have never operated at their nominal capacities. In recent years all capacity utilization has been at 30-40% (IMF, 2004). There is a legion of problems facing the refineries. The management of the Nigerian National Petroleum Corporation (NNPC) failed to implement regular Turn Around Maintenance (TAM) on various plants to prevent breakdowns and sustain high capacity utilization; this failure has been a major problem. The overhaul of the refineries is recommended to be carried out every 18 or 24 months. However, between 1992 and 1999, no TAM was carried out in Kaduna or in Port Harcourt refineries. NNPC management blamed this failure on lack of funds. The corporation said it was starved of funds during the military era. For instance, between 1994 and 1996, it got only 10% of its budgetary allocation from the federal government.

Figure 10 - Nigerian refining (1,000 bbl/d)



Source: OPEC Statistical Bulletin, 2006

One consequence of the deteriorating state of the refineries is the rise in import share of petroleum products in total domestic consumption. Nigeria continues to spend huge scarce

foreign exchange to import petroleum products. These imports are received into the country through two main import terminals at Atlas Cove and Port Harcourt close to the Port Harcourt refinery. Recently, the Nigerian government has started granting permits to build several independently-owned refineries in Nigeria.

Natural Gas in West Africa

West Africa contains approximately 32% of Africa's total proven natural gas reserves. Nigeria holds the largest proven reserves with 185 trillion cubic feet (tcf) within the ECOWAS region. However, proven reserves are also located in Côte d'Ivoire (1.0 tcf), Ghana (840 billion cubic feet; bcf), and Benin (40 bcf). Although natural gas is still in early stages of use in the region, several projects such as the West African Gas Pipeline (WAGP) and associated gas-fired plants, are under way that should increase the future use of the resource.

Table 4 – Natural gas in West Africa

	Nigeria	C. d'Ivoire
Reserves (% of world)	3%	neg.
Production (% of world)	1%	neg.
R/P (years)	184	22
Exports (% of cons.)	166%	0

Source: Energy Information Administration

Nigeria accounts for about 3% of world gas reserves and 1% of global gas production (Table 4). Since domestic consumption is still quite low, the country exports much more than it consumes, about 66% more. All other countries considered have very little or no gas reserves or production; Côte d'Ivoire hosts about 0.02% of world's proven reserves and produces about 0.04% of total gas production in the world, exporting none. Côte d'Ivoire has 1.0 tcf of proven natural gas reserves. Although exploration teams first discovered natural gas in Côte d'Ivoire in the 1980s, it was not until the mid 1990s that companies began to develop the resource. Côte d'Ivoire produces and consumes about 46 bcf of natural gas. The Ivoirian government estimates that natural gas consumption will grow by 50% over the next three years.

According to 2006 estimates by the Oil and Gas Journal (OGJ), Nigeria is the seventh largest natural gas reserve holder in the world and the largest in Africa. In October 2004, Nigeria announced that its natural gas reserves could be as high as 660 tcf. The government plans to raise earnings from natural gas exports to 50% of oil revenues by 2010, including exports as LNG or via pipelines such as the WAGP. However, the Nigerian National Petroleum Company (NNPC) estimates that $15 billion in private sector investments are necessary to meet its natural gas development goals by 2010. As of this report, WAGP and several LNG projects are completed but investments in capturing all of the flared gas and developing new gas reserves have been limited.

The vast majority of natural gas found in Nigeria is associated, meaning that it occurs in crude oil reserves as free gas. Because many of the fields lack the infrastructure to produce the associated natural gas, it is flared. Nigeria flares more natural gas than any other country in the world, with 43% of its total annual natural gas production being flared. NNPC estimates that Nigerian flared natural gas accounts for approximately 20% of the world total. The target date to end natural gas flaring was end of 2007; unfortunately, flaring continues. There is no new official deadline but newspapers quoted senior government officials as putting the new date at 2011. A significant portion of Nigeria's natural gas is processed into liquefied natural gas (LNG) for export purposes. Nigeria's most ambitious natural gas project to date, the $3.8 billion liquefaction facility on Bonny Island, was completed in September 1999. Since then, liquefaction capacity has been expanded several times. There is enough natural gas in Nigeria to meet all

export obligations, including LNG and WAGP, and domestic needs but as mentioned before, some of the investments have not taken place yet to stop flaring and develop new gas reserves.

The West African Gas Pipeline Project

Currently, only Nigeria and Côte D'Ivoire use natural gas in the region, mostly for power generation. The West African Gas Pipeline (WAGP) was initially developed to utilize some of the gas being currently flared in Nigeria for power generation in Benin, Togo and Ghana. The 687-km pipeline, whose cost is estimated at US$635 million, will supply thermal power stations in Benin, Ghana and Togo, yielding a capacity of 3,000 MW in 20 years time. It will complement the WAPP regional strategy for the development of hydroelectric facilities around the region. The project company is known as WAPCO and its partners are:

- Chevron West Africa Gas pipeline Ltd 36.7%
- NNPC 25%
- Shell Overseas Holdings Ltd 18%
- Takoradi Power Company Ltd (Volta River Authority) 16.3%
- BENGAZ (Benin) and SOTOGAZ (Togo) 2% each

The pipeline is developed with the goal of reaching an ultimate capacity of 470 million cubic feet a day (mmcf). In the beginning, though, a smaller foundation market is envisioned. Ghana is the main market for the natural gas, accounting for roughly 75% of a foundation volume of 134 mmcf per day. Initially, natural gas will primarily be used for power generation at the Takoradi Plant in western Ghana. However, there have been delays in gas delivery through the WAGP. The pipeline construction was delayed for various reasons; including a ship's anchor accidently tearing through the underwater pipe offshore Benin. Although the construction is now mostly complete, there are some remaining issues:

- Gas supplies in Nigeria are not sufficient; only up to 60 million cubic feet a day (more likely, 30 mcfd) can be shipped as free flow. This shortage is caused mainly by
    - the lack of investment in gas development (to capture flared gas and to develop new fields), which is often considered a result of tiered pricing approach under the Gas Master Plan of Nigeria. Significant amounts of gas will be used for power generation; and the price of gas for power generation is criticized for being too low to provide enough incentive to producers. There is a three-year transition period, over which the price of gas is expected to rise to market levels.
    - the disconnect between eastern and western pipeline networks in Nigeria, which is again blamed on insufficient price signals from the tiered pricing approach of the Gas Master Plan.
    - the increased demand for gas in Nigeria (primarily for power generation).
    - the increased demand for gas in LNG exports.
- The gas that is available is wetter than the gas that can be shipped via the WAGP under contract terms. And the liquids in the Escravos-Lagos pipeline needs to be removed.
- Even if there was sufficient gas to meet foundation volumes, the compressor station will not be ready until March 2009.
- The overarching concern in Nigeria, though, remains to be the unrest in Niger Delta, which undermines the flow of investment that could have addressed almost all of the issues listed above.

In the medium to long-term, increased demand for gas in the region will put more pressure on the market. Many more gas-fired power projects than originally envisioned have been put

forward not only in WAGP countries but also in Côte D'Ivoire (there is provision for WAGP to be extended to Côte D'Ivoire). However, commercial arrangements with producers in Nigeria are mostly lacking.

Table 5 – WAGP Development Issues – Scorecard

Issue	Comment
Gas availability	Improving economic environment for investors
Gas specifications	Shell to provide gas processing facilities
Volume of free flow gas	NGC to increase pressure in ELP
Limitation of the pipeline capacity	WAPCO to add one more compressor
Security of the pipeline	Offshore Damage Prevention Program
Deadline completion date	Agreement on a new completion deadline with provisions for compliance
Funding of the WAGP Authority	Review of WAGPA charge for full compression; Set WAGPA charge for free flow gas

The delayed delivery of natural gas through WAGP had a real cost on the participating countries' economies. For example, in the absence of natural gas, Ghana had to import light crude oil for the Takoradi plant that also had to run more due to low water levels at the Akosombo dam during a period of high oil prices. A rough estimate of the cost of incremental oil imports in Ghana is $650-700 million in 2007 and first six months of 2008 as compared to about $325 million in three previous years (2004-06). The increasing share of oil-fired power in the system also caused electricity prices to go up, increasing the cost of doing business in Ghana. The situation is similar in Benin, Togo and even Nigeria.

Energy Security and Diversification

Fundamentally, improving energy security is about ensuring availability of reliable energy services to the economy. As such, diversification has been at the heart of strategies followed by countries around the world. In particular, experiences of countries with little domestic resources, such as Japan, France, South Korea and Singapore, that have yet been able to sustain economic growth, provide a set of strategies that have proved successful in most circumstances. Most common are the following:

- increasing the number of fuels and technologies that are in the energy mix;
- increasing the number of suppliers for each fuel (especially if imported);
- increasing energy efficiency and conservation; and
- developing storage capacity for different fuels (e.g., strategic reserves).

The previous discussion shows the tenuous situation of energy security in the West African region; there is limited diversification of energy sources and sources of supply for heavily used fuels such as crude oil and its products. Simple macro level indicators, which reflect various energy security dimensions, are practical tools for various stakeholders involved in the policy development process. Recently, a set of energy security indicators are developed by modifying the Shannon-Wiener Index, a diversity index first used to measure biodiversity.[4] Indicators are defined and calculated somewhat differently across studies that reflect the policymakers'

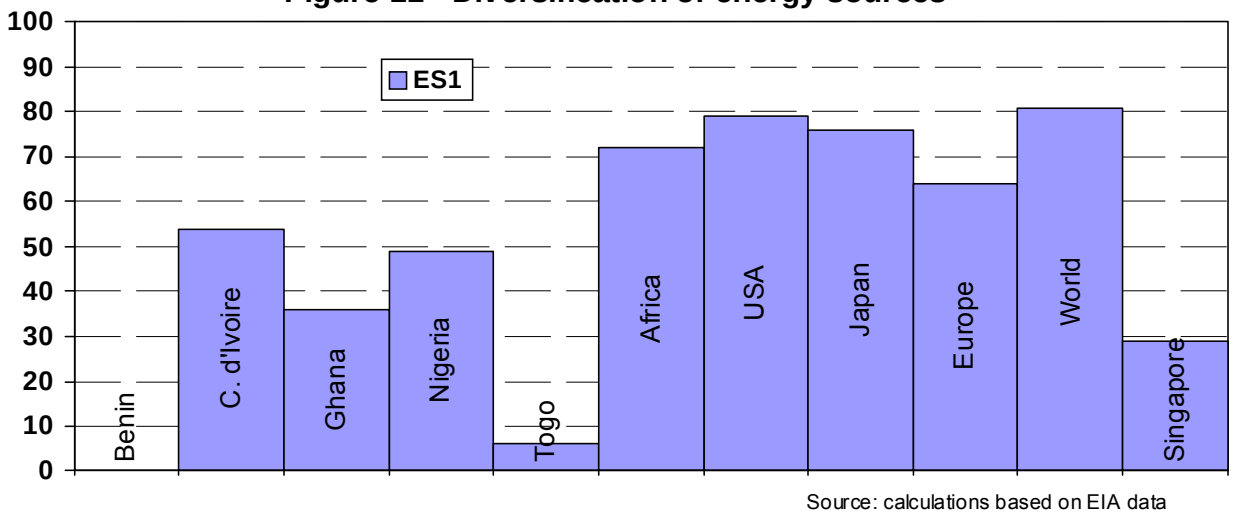
[4] For example, see Designing Indicators of Long-Term Energy Supply Security by J.C. Jansen, W.G. van Arkel and M.G. Boots for the Netherlands Environmental Assessment Agency; Strategies for Energy Security – A Transatlantic Comparison by Christian von Hirschhausen, German Institute for Economic Research; A Quest for Energy Security in the 21st Century: Resources and Constraints, Asia Pacific Energy Research Center (APERC), 2007.

preferences regarding factors they would like to capture in each indicator (e.g., political stability of import sources) as well as technical considerations such as statistical normalization. We offer one such indicator on diversification of energy supply sources that considers both the significance of diversification in terms of abundance and equitability of sources:

- $ES1=-(\sum a_i \ln(a_i))/\ln(6)$ where a_i is the share of each of six primary energy sources (oil, natural gas, coal, nuclear, hydro and renewables) in total energy consumption.

To calculate the indicator, the data reported in previous tables and figures are used, mostly from the EIA. The indicators confirm the discussion presented above. For comparison purposes, index values are also provided for various regions of the world. Benin and Togo have not been able to diversify their energy sources, relying heavily on imported oil products. Natural gas from WAGP and hydroelectricity from WAPP will hopefully change this situation. Ghana is in a better situation but it is basically a two-fuel economy, oil and hydro. Again, natural gas from WAGP will help Ghana diversify its energy portfolio. Nigeria and Côte D'Ivoire are the most diversified with scores around 50 but relative to most regions of the world, including Africa, which scores 71, there is room for improvement (Figure 11).

Figure 11 - Diversification of energy sources



Source: calculations based on EIA data

It is worth noting that the low score is not necessarily a handicap; Singapore, with an ES1 score of below 30, has been able to sustain its economic development over the years, probably by managing this lack of diversification with the help of efficiency and conservation programs among other initiatives. By contrast, another country without domestic resources, Japan, has been able to achieve a high score of 76 by diversifying its energy sources and increasing the number of import origins for the fuels the country imports. Japan is often credited for giving birth to the global LNG trade in the late 1960s.

Energy Policy in West Africa

There are presently on-going reforms in the energy sector in most of the countries. Energy sector reforms are included in the countries' Poverty Reduction Strategy Papers (PRSPs). In the electricity sector, reforms were undertaken to change the prevailing regulations, modes and forms of company ownership (privatization) with a view to increasing the sub-sector financial viability. Most of the countries are also exploring the use of Private Public Partnership in

delivering energy services. The liberalization of liquefied petroleum gas fuel distribution sub-sector and efforts to foster competition should bring down the cost of modern fuels such as LPG while enhancing the quality of the products. Countries like Nigeria have also established the Rural Electrification Board to promote electricity access in the rural areas.

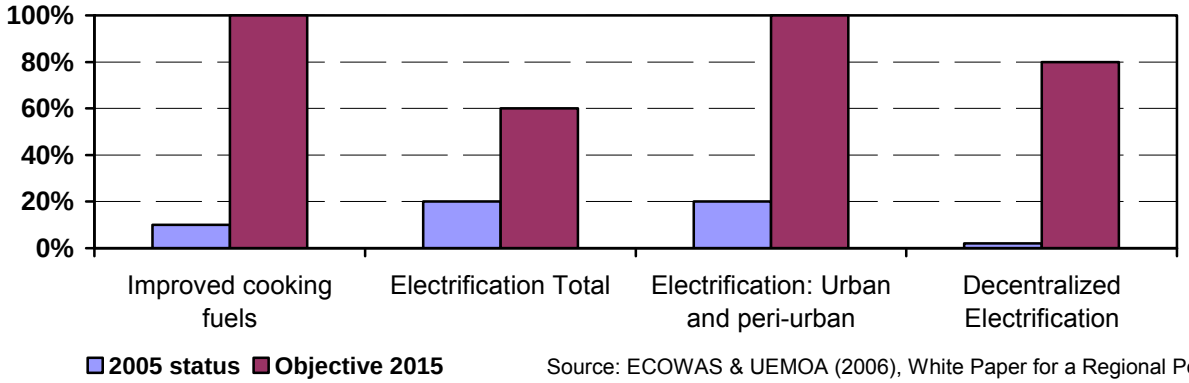
Many national markets in the region are too small to justify the investments needed to develop typically large energy production and delivery infrastructure projects. Inefficient management of utilities, corruption, protracted conflict and short-sightedness have deprived most countries of the energy supplies needed to fuel the growth process. In many cases the needed investments to rejuvenate the energy sector are beyond the financial capacity of the domestic economy — both public and private. Moreover, the activities of public utilities often have a huge impact on the management of the economy, especially when imported fuels are bought in foreign exchange and end-users pay in local currency at rates below full-cost recovery.

Recently ECOWAS set up a Regional Committee on Energy Access to address the problem of lack of energy access in the rural and peri-urban areas. The regional policy objectives articulated under the Regional Energy Access Programme are enunciated below:

1) 100% of the total population or 325 million people will have access to a modern cooking facility by 2015
2) At least 60% of people living in rural areas will reside in localities with access to motive power to boost productivity and also have access to modern community services
3) 66% of the population or 214 million people living in rural areas will have access to individual electricity services, that is:
    a) 100% of urban and peri-urban population
    b) 36% of rural population
    c) Moreover 60% of the population will live in localities with:
    i) modernized basic social services – healthcare, drinking water, communication, lighting, etc
    ii) access to lighting, audiovisual, and telecommunication services
    iii) coverage of isolated population with decentralized approaches

Figure 12 shows the expected changes in various aspects of energy access in the sub-region between 2005 and 2015.

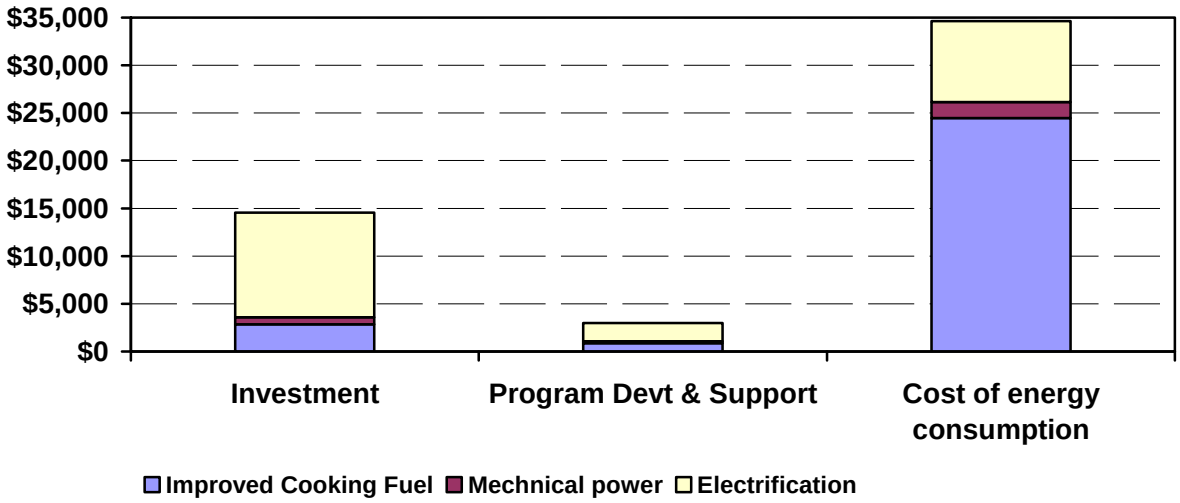
Figure 12 - ECOWAS energy access goals



Source: ECOWAS & UEMOA (2006), White Paper for a Regional Policy

The investment program to cover the attainment of these objectives has also been carefully worked out. Each of the targets is to be covered by a specific investment program in order to assign the resources needed for the achievement of the set objectives. It is estimated that an amount of about US$17.5 billion will be required over ten years for investment in equipment needed for access to modern energy services including studies and accompanying measures. An additional US$34.6 billion is needed over ten years to cover energy costs. The total annual cost for program is estimated at US$52 billion, around 4.3% of regional GDP. This translates to about US$16 per inhabitant per year. Figure 13 shows the investment structure for the various programmes.

Figue 13 - Investment needed to achieve access goals ($million)



Source: ECOWAS & UEMOA (2006), White Paper for a Regional Policy

In order to remove the main obstacles to the implementation of major activities envisaged in the ECOWAS White Paper, four main themes of actions for the region were identified. Building capacities of public and private actors is the first theme, which will cover the development of tools and methods, and training of actors on how to use and appropriate them. These tools will also make it possible to monitor and implement policies and programmes and assess the results obtained and their impact on poverty eradication and economic development.

The second line of action is to help raise soft loans and finance from the private sector for projects aimed at extending energy services to rural and peri-urban areas. These funds would complement those from national budgets, especially via debt remission initiatives schemes, and which are necessary for the implementation of energy programs.

The third line of action is exchanging, promoting and disseminating sub-regional experiences of supplying energy services in rural and peri-urban areas. The ultimate goal here is to create a system for sharing knowledge and good practices, which will serve as a springboard for the capacity building strategy by stimulating the setting up or the reinforcement of a multi-sectoral dynamic both at national and regional level, and the fostering of an expertise based on a community with a practical experience.

Finally, there is the promotion of local production of energy goods and services. Increased local production will afford the region the opportunity to establish a network of private suppliers capable of catering to the demand for energy equipment and services.

Other Efforts at Regional Level

There are additional efforts in the region. One of the strategies to enhance energy security in the region is to diversify the electricity supply base of the countries. The dependence of the countries on thermal and hydro has met with significant challenges leading to supply disruptions. There is also the problem of environmental constraint associated with the use of oil and hydro in the generation of electricity. We can then add to this the low population density of many countries that for instance make grid connections to people living in rural areas very expensive and difficult. Hence there has been recourse to other initiatives to expand access to modern energy in the region.

- The Regional Solar Program (RSP) seeks to use solar energy in rural areas to provide the population with energy and drinking water (by powering pumps). The program was launched in the late 1990s by the Interstate Committee for Drought Control (CILSS) and was backed by the European Union. It aims at promoting the use of photovoltaic solar power, particularly for water pumping, in order to meet the needs of the main urban centers in Sahelian countries.
- The regional program for the promotion of Household and Alternative Energy in the Sahel is an initiative to help member states design, adopt and implement their domestic energy strategy. The program is implemented by CILSS and Sahelian governments with the support of the EU and the German Co-operation Agency.
- The Multifunctional Platform Project (MFP) aims at bringing motive power to the rural areas. The project was initiated in Mali in 1996 with the backing of UNDP and UNIDO and has been extended to Senegal, Burkina Faso, Ghana, Nigeria and Guinea. Its goal is poverty reduction as a whole but specifically poverty of rural women by enabling them to create income-generating opportunities through the supply of energy services.
- The Regional Biomass Energy Program (RBEP) aims at helping member states of UEMOA to conceive and implement projects and programme on modern uses of biomass. The program is implemented by UEMOA with the support of Dutch cooperation.
- Regional Centre for Small Hydro with headquarters in Nigeria was to promote the development of small hydro facilities that are prevalent in different parts of the region to provide electricity for neighbouring communities. This centre is the brainchild of UNIDO. The centre also has as part of its mandate to facilitate the development of cost effective technology, capacity building and training and awareness program on small hydro projects.
- An Energy Observatory (Energy Information System) was set up in 2003 to monitor and record energy flows across the regions. The WAPP Information and Coordination Centre has since taken over the responsibilities of the Energy Observatory and now serves as an information, monitoring and early warning system on the state of the energy sector un the region.

Moving Forward

Countries in West Africa are heavily dependent on oil and hydroelectricity for their energy needs. Except for Nigeria and Côte D'Ivoire, imports are essential for other countries. As the country grows, even Côte D'Ivoire will have to start importing increasing amounts of oil and natural gas unless new domestic reserves are proven. Although Nigeria is said to have 185 tcf of natural gas reserves, the country continues to flare significant amounts of associated gas produced along with oil. There is also untapped hydro capacity around the region. In the absence of these commercial energy services, biomass plays a dominant role in the region's energy portfolio, wasting people's times, endangering human health, reducing productivity and degrading the environment.

Two regional projects, WAGP and WAPP have the potential to improve the level of access to commercial energy services around the region. However, infrastructure investments are large and require investment conditions to improve within the individual countries and across the region. Price subsidies, high system losses, poor financial status of state enterprises and implementation of simple regulatory frameworks are all among the challenges that need to be addressed. Adjusting prices of natural gas and electricity in a way to allow cost recovery so as to attract investment in power plants, pipelines and other infrastructure is needed but must be balanced with improved communications with consumers and visibly improved service quality. Regulators and state utilities should be empowered to do their jobs, while investors are encouraged to finalize commercial deals to secure gas supplies (domestic production or imports) or alternative fuels to meet growing energy needs in a sound way.

In this report, we tried to provide status report on these major projects in addition to general energy situation in five countries, with the hope of contributing to consumer education and policy discussions. In future reports, we expect to continue with regular updates on these projects and other sector developments.