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# Sub-Sahara Africa

## Energy and environmental challenges

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# SUB-SAHARA AFRICA: ENERGY AND ENVIRONMENTAL CHALLENGES[1]

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**Abstract**

The availability of energy is an important factor in Africa's current economic recovery efforts. However, environmentally unsound production and utilization of energy resources have already created development hazards of their own. Such problems include enhanced desertification, drought, pollution, and the contribution of gaseous emissions to global warming.

This paper reviews the environmental impacts of energy production and utilization in Kenya and Nigeria. The focus is on national energy and environmental policies, institutions and management capabilities. The paper advocates active demand management strategies achieved through fiscal and institutional reforms. Meanwhile, under the current high tide of global environmental awareness and cooperation, opportunities for regional and extra-African cooperation on energy and the environment will also need to be explored.

[1]*Acknowledgments:* This paper is a product of a two-month fact-finding trip to Kenya and Nigeria in January and February 1992. In Nigeria, I enjoyed the hospitality of the Nigerian Institute of International Affairs as a Visiting Fellow. I also benefitted from the insights of Calestous Juma of the African Centre for Technology Studies, Nairobi on issues pertinent to Africa's rough road to sustainable development. Finally, the comments of Dana Gustafson and Arild Underdal have significantly helped to improve this final version.

# 1 Introduction

Africa is a continent of tremendous paradox. The region is endowed with 55 billion barrels of proven oil reserves, 5,900 billion cubic meters of natural gas, mostly in North Africa; 88.5 million tonnes of coal, mostly in Southern Africa; peat and lignite deposits; tonnes of uranium; 200,000 megawatts of untapped hydropower; great potentials in solar energy, considerable geothermal prospects and biomass resources. In all, the continent possesses over 6% of total world proven fossil and hydro energy reserves, yet it consumes less than 3% of it. The insecurity and insufficiency of commercial energy supplies, high fossil energy import bills, overpopulation and desertification have contributed to constrain major development efforts in Africa and threaten the maintenance of a sound ecological integrity.[1]

The interplay between the current breakdown in economic development, hunger, energy scarcity and an overstressed environment has tended to reinforce each other and has exacerbated the decline in human conditions, especially among the states of the sub-Sahara.

This paper reviews current issues in the interaction between energy utilization and its compatibility with local and global environmental concerns in sub-Saharan Africa. Taking a point of departure from two countries, each on the opposite ends of the region's energy surplus/deficit continuum, attempts shall be made to assess their energy balances, policies, institutions and the maintenance of sound environmental integrity.

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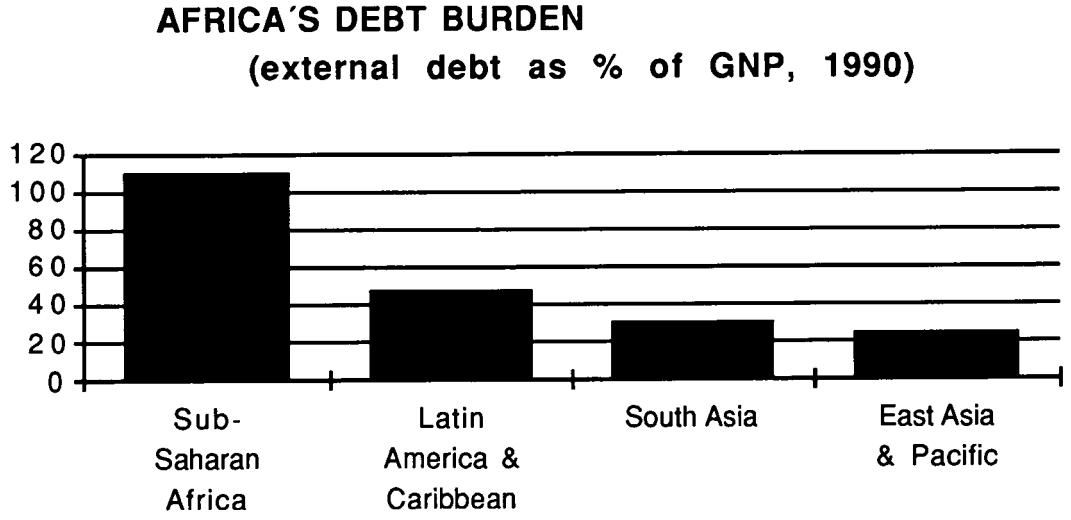
[1] According to World Bank (1989) proven reserves of petroleum in the sub-Saharan region was 20.5 billion, equivalent to 2.3% of world total. It has 3.5% of the worlds known natural gas reserves. At the current rate of consumption, the natural gas reserves can supply the sub-region for over 120 years. The current installed capacity of hydro power can be boosted twenty fold. However, these resources are unevenly distributed. While Nigeria and Angola alone possess 80% of total proven petroleum resources in the sub-region, petroleum import represents the largest share of total imports in most of the other countries. It is however believed that with intensified exploration activities more reserves of fossil energy may be located. The number of drilled exploratory holes in Latin America per annum is ten times the number drilled in sub-Saharan Africa.

Kenya and Nigeria have experienced enormous but vacillating economic growth rates over the post-independence years. However, they differ greatly in energy endowment and approach to energy resource management. By assessing the interplay between energy and ecological concerns in these two states we hope to be better enlightened on the dynamics of the current crisis affecting Africa's energy sector.

## 1.1 Economic Development

A cursory inventory of the state of human conditions in Sub-Sahara Africa reveals a miserable picture of a failed development project. The 1980s witnessed a reversal of the improvements in standards of living attained by the region in the first two development decades. Per capita gross national product (GNP) was falling at the rate of 4.2% a year. It was the only place in the world where per capita food production and consumption were declining, and this is without prejudice to the fact that Africa has twice the size of China's arable land, but inhabits half the size of that country's population. Africa has the world's highest rate of population growth, by far the highest fertility rate; the highest infant, child and maternal mortality rates; and the lowest life expectancy. It has the heaviest reliance on imported food; (producing essentially what it does not consume and consumes what it does not produce); the greatest proportion of land area losing its fertility, and the largest percentage of the population suffering from severe malnourishment. It has the world's greatest dependence on fuelwood for energy. Meanwhile, the sub-Saharan region accounts for a mere 1% of the world's total commercial energy consumption.

Figure 1




Source: *Africa Recovery (1991)*

At the same time the servicing of debts has been soaking up a large chunk of earnings from exports of primary products. Sub-Sahara Africa's international indebtedness amounts to $161 billion. This represents 112% of the sub-region's total GNP.

## 1.2 Population, Energy and Environment

Energy is a key variable in the development process. The linkage between energy systems in use in a society has a strong correlation to the level of growth, socioeconomic distribution, ecological balance and is often predictive of the growth in populations.[1]

With Africa's 3.0% growth in population, the continent is likely to double its present population to an estimated one billion people over the next two decades. The urban population will likely quadruple. Overall, more than 40% of the new inhabitants will be under 14 years of age.[2] This will have serious implications for the quantity and form

[1]For a taxonomy of economies, energy dynamics and population tendencies, see Nkum, J.O.C (1991) et al.

[2]OAU/UNEP (1991) *Regaining the Lost Decade - a Guide to Sustainable Development in Africa.*

of energy required by various sectors of the economy, and will certainly exert pressure on different ecological systems.

Biomass is expected to remain the major source of energy in the region for a long time to come. At today's level of consumption, further stress will be put on the already fragile biospheric systems. Africa is currently losing between 3-5 million hectares of tropical forests each year through deforestation. Should this rate of loss continue, tropical forests in Africa will be gone within 60 years. This will have serious consequences on the region's capacity to meet the already precarious food situation, the provision of household energy, the protection of a rich diversity in flora and fauna, as well as its potential contribution as sinks for $CO_2$ emissions.[1]

Africa's demographic development has however, become a contentious and politicized issue. Nevertheless, there is a large consensus that if current rates of population growth continue unmanaged, the crucial balance between people, resources, environment and their capacity to improve human conditions will collapse.

Table 1

Per Capita Energy Consumption in giga-joules and Percentage Population Change 1985-90

| | Per capita energy consumption (1990) | % change in pop. 1985-90 |
|---|---|---|
| **Africa** | 12 | 3.00 |
| **USA** | 280 | 0.82 |
| **S. America** | 30 | 2.07 |
| **Asia** | 21 | 1.85 |
| **Europe** | 130 | 0.23 |
| **USSR** | 194 | 0.78 |

Sources: World Resources Institute (1991) *World Resources 1990-91*
UNDP (1991) *World Development 1991*

[1] Serageldin, Ismail (1990) *Saving Africa's Rainforests*

Further, at current rates of population growth, achieving The World Bank's targeted economic growth of about 4-5% for the sub-region will be too ambitious and might under a low energy case scenario require an expansion of commercial energy use in Africa to over 5% per annum.[1] This may triple per capita modern energy use. With no change in the mix of energy sources, Africa's $CO_2$ emissions will increase by 374 million tonnes a year, from 156 in 1985 to 560 million tonnes by 2005.[2] Africa's prospective modern use could be large enough to make a difference in the global efforts to curb the emission of greenhouse gases.

Finally, increased rate of population growth will lay claim on the region's capacity to meet the educational, health, and nutritional needs of its peoples. Presently, national economies are already under severe stress.

## 1.3 Sub-Sahara Africa's Energy Balance

Sub-Sahara-Africa is richly endowed with modern energy resources. Large amounts of coal are available in the south in South Africa, Botswana, Swaziland, Zimbabwe, Nigeria in the west and relatively smaller amount in other countries. Proven reserves of natural gas have been found in Angola, Namibia, Nigeria and Gabon. Oil is available in Gabon, Cote d'Ivoire, Nigeria, Cameroon, Congo and Namibia. Reserves of uranium are found in Namibia, Zaire, Niger, Gabon and South Africa. Hydro power is also available in a large number of these countries.

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[1] World Bank (1989) *Sub-Sahara: Africa From Crisis to Sustainable Development*
[2] Leach (1990) *Carbon Dioxide Emission Strategies: Africa*

Table 2

Africa's Share of Total World Commercial Energy Reserves

| | Africa | World | Share of World Total |
|---|---|---|---|
| **Oil** | 7.9 | 136.5 | 6.0% |
| **Gas** | 8.1 | 119.4 | 6.7% |
| **Coal** | 62.4 | 1078.7 | 5.8% |
| **Nuclear** | --- | --- | --- |
| **Hydro** | --- | --- | --- |

Sources: BP (1991) *BP Statistical Review of World Energy*
*World Resources 1990-91*
Measurement: Oil reserves measured in 1000 million tonnes
Natural Gas reserves measured in trillion cubic meters
Coal reserves measured in billion tonnes

In addition to the energy forms in tables 2 and 3, biomass in the form of fuelwood, charcoal, ethanol, biogas and agricultural residues make up about 80% of the total energy needs of the region. In many countries, like Burkina Faso, Ethiopia, Malawi, Tanzania and Uganda, the proportion is well over 90%[1] Modern use of biomass has been vigorously developed in a few African countries, including; Kenya, Botswana and Malawi. In Nairobi, cars use a blend of gasoline and ethanol to a proportion of 90% and 10%, respectively. In Malawi and Botswana ethanol is blended with gasoline in a proportion of about 20% and 12%, respectively.

[1]Beijer Institute (1984)

Table 3

Africa's Share of Total World Production and Consumption of Commercial Energy

| | Production | | | Consumption | | |
|---|---|---|---|---|---|---|
| | Africa | World | Share of World Total | Africa | World | Share of World Total |
| Oil | 313.5 | 3148.9 | 10.0% | 93.9 | 3101.4 | 3.0% |
| Gas | 60.6 | 1761.6 | 3.4% | 32.9 | 1738.1 | 1.9% |
| Coal | 99.2 | 2178.0 | 4.6% | 75.6 | 2192.1 | 3.4% |
| Nuclear | 2.7 | 461.1 | 0.6% | 2.7 | 461.1 | 0.6% |
| Hydro | 19.7 | 540.6 | 3.6% | 19.7 | 540.6 | 3.6% |
| **Total** | **495.7** | **8090.2** | **6.1%** | **224.8** | **8033.3** | **2.8%** |

Sources: BP (1991) *BP Statistical Review of World Energy*
*World Resources 1990-91*
Measurement: Oil reserves measured in 1000 million tonnes
Natural Gas reserves measured in trillion cubic meters
Coal reserves measured in billion tonnes

Apart from the largely untapped hydropower resources, one of Africa's greatest potential source for sustainable energy supply is through the exploitation of solar power. So far, this resource has only been marginally developed. Wind and wave power are other areas with promising prospects. However, the development of these resources has been difficult due to the large financial investment, and the technological and manpower requirements that are involved.

## 1.4 The Nature of the Challenge

### *1.4.1 Commercial Sector*

In the mid-1980s per capita commercial energy consumption was falling in most countries, including 9 petroleum producing countries

and most of the least developed countries in the region.[1] At the same time, among the energy deficit countries, energy imports as a percentage of total exports rose from 7% in 1965 to 28% in 1989. Some countries spend over 40% of the total value of their exports to finance energy bills. Per capita energy consumption in the region has remained less than half the average of Third World countries.[2]

The global energy price rises left many African countries unable to afford the huge import bills required to meet the rising needs for fossil fuels caused by growing populations, industry, agriculture and expanding cities. While woodfuel accounts for more than 80% of Africa's energy consumption, scarce resources for investments remain tied to consumption of largely imported commercial fuels, creating air pollution and other health hazards in urban centers.[3]

Reduced capacity utilization in existing facilities due to the lack of relevant manpower and foreign exchange for the purchase of spare parts is a common feature in the electricity generation and petroleum refining sectors. According to the World Bank's perspective study for Africa, to achieve the needed 5% expansion in energy production, Africa will have to invest $28 billion during the next ten years, equivalent of about 2% of GDP annually. In the 1990s alone, $11 billion will be required to finance expansion in the region's electricity sector.[4]

### *1.4.2 Traditional Energy Sector*

In the traditional energy sector, the continent has been experiencing a declining forest cover, and an increasing share of urban household income is spent on fuel. In many parts of Africa, women and children spend a whole day's work on the gathering of fuelwood. As access to fuelwood deteriorates, families turn to the burning of animal and crop

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[1] United Nations Economic Commission for Africa (UNECA) (1990) *Transition to Sustainable Energy for Development under Climate Change in Africa, some Problems and Prospects*

[2] The term "Third World" is being used in the paper only as a shorthand. For all substantive purposes, the concept has lost its analytical usefulness as there is currently no Second World. Moreover, there are presently great disparities in economic development between the former "Third World".

[3] OAU/UNEP (1991) *Regaining the Lost Decade*

[4] See World Bank (1989) *Sub-Sahara Africa - From Crisis to Sustainable Development*

wastes. This leads to the rising demand for the production and importation of fertilizers for replacement of the lost soil nutrients.

According to Adegbulugbe, a Nigerian energy-policy expert, there are perhaps three ways to classify the environmental implications of energy production and use in Africa: i) desertification and deforestation; ii) pollution; and iii) climate change.[1] Some of these ecological situations may of course, not be the direct products of energy-related activities.

### *1.4.3 Deforestation and desertification*

Wood logging in countries like Zaire, Cote d'Ivoire and Cameroon is contributing to the extensive decline in Sub-Sahara Africa's forest cover. However, for most of the region, deforestation and desertification have been enhanced by the "mining" and burning of biomass for fuel. This has been accentuated by increased poverty and the inability to switch fuels, population growth and increased demand for household energy, the inefficient technology of wood combustion throughout the region (traditional three-stone stoves burn at 15%-20% efficiency). The excessive pressure on forests can also be blamed on the open access to land and the mining of wood as a "free good."

Natural processes have in the past decade enhanced the impact of human activities in already marginal lands in the region. Desert encroachment in the Sahel and Kalahari regions of the continent continue to make rehabilitation of marginal lands difficult. The cumulative consequences contribute to further pressure on wood resource bases.

### *1.4.4 Pollution*

In-door burning of fuelwood and kerosene are major sources of pollution and health hazards in homes. In the rural areas, bush burning contributes most to air pollution while transportation accounts for a large share of the air pollution in African cities.

The increasing tendency of urbanization, population growth, poor institutional controls, inefficient fuel combustion technologies in industries, transportation and household use of energy are some of the

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[1] Adegbulugbe A.O. (1991a) *The Energy and Environment Nexus - The Role of Energy Efficiency.*

underlying causes of the increase in pollution and its danger to human health. Sub-Saharan African states with heavy industries and large transports sector like Nigeria and South Africa are especially exposed to this problem. Currently pollution from South African coal powered industries are causing acid precipitation neighbouring countries. Gas flaring and oil spillage from major petroleum producers like Nigeria and Gabon, increase in vehicular emissions in cities as well as bush burning for hunting, agricultural or cultural purposes - all increase the level of pollution to disturbing proportions.

Apart from Cameroon, none of the countries of the region have lead-free gasoline.

### *1.4.5 Climate Change*

Climate change has until recently received marginal policy attention in the region. Greenhouse gas emissions from Africa's industrialization, gas flaring associated with oil production, combustion from the transportation sector, land clearing and deforestation are major culprits in enhancing the build-up of greenhouse gases. Emissions from industrial and transportation

Table 4

Total primary energy supply projections for Sub-Saharan Africa (mtoe)

| | Actual | | Projected |
|---|---|---|---|
| **Energy source** | 1960 | 1986 | 2020 |
| **Commercial** | | | |
| **Petroleum** | 5.6 | 24.0 | 140 |
| **Natural Gas** | 0.0 | 3.0 | 30 |
| **Electricity** | 0.5 | 3.0 | 20 |
| **Coal** | 3.5 | 4.0 | 10 |
| **Subtotal** | 9.6 | 34.0 | 200 |
| **Woodfuel** | ... | 66.0 | 200 |
| **Total** | | 100.0 | 400 |

Source: World Bank (1989) *Sub-Sahara Africa - From Crisis to Sustainable Growth.*
mtoe = million tons of energy equivalent

sectors might be small based on global levels, but most projections suggest that energy consumption will increase to significant levels by the turn of the century. According to World Bank projections, energy use in the region will increase by 300% by the year 2020. (See table 4)

There is a shortage of good estimates on Africa's emission of greenhouse gases. Uncertainties also prevail over the contribution of forests, savannahs and bush burning.[1]

[1] In the article, *African Forests and Grasslands: Sources or Sinks of Greenhouse Gases*, attempts were made by Hall D.O. and Rosillo-Calle, F. (1991) to conceptualize the contribution of grasslands and forests.

Table 5

Per capita emission of $CO_2$ in 1988 (million tons)

| | World | OECD | Africa |
|---|---|---|---|
| Oil | 2294 | 1294 | 66 |
| Gas | 890 | 420 | 18 |
| Coal | 2484 | 891 | 72 |
| | 5668 | 2605 | 156 |
| Population (million) | 4971 | 789 | 589 |
| per capita (kg) | 1140 | 3482 | 264 |

Sources: Energy: *BP Statistics of World Energy* (BP 1988)
Population: UNDP *World Development Report 1987*

Africa's per capita greenhouse gas emission is low by world standards. Table 5 shows the region's per capita share of emissions to be over four and twelve times less than world and OECD averages, respectively. However, with the 3-5 million hectares of tropical forests lost through deforestation every year, the estimated 130-200 million tonnes of $CO_2$ released every year from biomass burning in the region and the expected growth of 4-5% in commercial energy consumption, Africa's contribution to the world's total will show an increasing trend. Estimates from 1990 are on table 6.

Table 6

Comparison of $CO_2$ and Methane Emissions

| | *$CO_2$* | *Methane* | *Combined Effect* |
|---|---|---|---|
| **Africa** | 240,000 | 57,000 | 340,000 |
| **Europe** | 520,000 | 85,000 | 1,100,000 |
| **North and Central America** | 670,000 | 190,000 | 1,300,000 |
| **World** | 3,700,000 | 800,000 | 5,900,000 |

Source: World Resources 1990-91
Carbon dioxide heating equivalent `000 metric tons of carbon

Meanwhile, four factors are likely to accelerate Africa's potential contribution to global warming. One is population increase, two, the rapid rate of land clearance and deforestation; three, Nigeria's gas flaring; and four, the low rates of improvements in energy efficiency in all sectors, including household, transportation and industrial sectors. However, future $CO_2$ emissions will be dependent on economic, demographic, technological, institutional and policy developments.

Lastly, as long as the region's dependence on wood supplies for a large proportion of its energy needs remains unchanged, climate change induced by global warming will subject Africa's dryland ecology to more frequent and severe drought. Reforestation efforts in such conditions will be extremely difficult as plant growth will be severely hampered. This will certainly worsen the current food and fuel crisis in over 33 countries, especially in the rural areas. As the stock of wood shrinks, pressure will turn on reserved areas thereby creating a destructive circle on both local needs and global climatic concerns.

## 1.5 Review of previous studies

States of the sub-Saharan region share some basic economic and ecological characteristics. Their economies are undergoing major structural crisis due to a crippling debt burden, dependence on exports

of few primary products, balance of payment difficulties, declining infrastructure, technological retardation, population growth, etc. At the same time, they also share common natural ecological crises such like desertification and drought. In the past decade, a few studies have focused on the energy and environment perspective of the African crisis.

Perhaps a cornerstone was laid by the launching of the World Bank/UNDP *Energy Sector Assessment Program* in 1983. The programme was designed to increase the effectiveness with which energy resources are used. In country studies so far produced, attempts were made to put energy in a management perspective through policy and institutional reforms. With the long term perspective study: *Sub-Sahara Africa- From Crisis to Sustainable Growth* produced by the Bank in 1989, constraints to energy management were also highlighted. The study proposed among other things, a boost in commercial energy supply through least-cost mixes of domestic, imported and inter-country energy resources; strong inter-country cooperation, the creation of an enabling environment for investment in oil and gas prospecting and development; energy efficiency and research into energy efficient technologies; and concerted efforts to tackle the woodfuel crisis at national, sub-regional and regional levels. The price tag for annual investments in the commercial energy sector by the year 2000 was estimated to be $4.7 billion.

While the World Bank's approach continues to have an urban-bias, favouring the so-called commercial energy sector, the Beijer Institute study; *Energy, Environment and Development in Africa* made an impact by refocusing on the role of woodfuel as a focal point in the energy economy of sub-Sahara African states. Their studies prepared the groundwork for several other country studies mostly in the East and Southern African sub-region.

Most recently an energy NGO network, the East African-based African Energy Policy Research Network (AFREPREN) has in the past few years contributed to redirect attention to the common dynamics of the African energy crisis. The network was established in 1989 and funded by the Swedish Agency for Research Cooperation with Developing Countries (SAREC). AFREPREN draws energy professionals together from 16 countries of the East, Central and Southern Africa. In

their paper, *A New, Environmentally-sound Energy Strategy for the Development of Sub-Saharan Africa*, AFREPREN resounded the proposals for investment in energy efficiency, enhanced supply of modern fuels, maintenance of electricity and petroleum infrastructures. It also proposed increased financial resource mobilization in energy development and the development of policy instruments and institutions.

Every source of energy has its own economic and environmental costs, benefits and risks. Making choices based on knowledge of economic and environmental implications is an imperative. The three studies reviewed above have helped to call attention to the precarious energy situation in the region. However, energy policy-makers in the region are yet to enjoy the benefit of informed choices. National inventory of energy supply and demand are insufficient, where they exist, and are lacking in many countries. Common in all countries, is the lack of data on biomass consumption, standing stock of savannah and forest resources. Most of the figures generated from both United Nations and independent sources are often guesstimates and products of desk-top research.

However, independent of the present inadequacy of data on energy and environment in the region, common features in the case of Nigeria and Kenya are discernible.

# 2 Kenya

## 2.1 Economic Development

Kenya's economy has experienced periods of tremendous growth since independence. In 1965 the Government launched the country's official development ideology entitled *African Socialism and Its Application to Planning in Kenya.* Emphasis was placed on economic growth. While "other immediate problems such as africanization of the economy, education, unemployment, welfare services, and provincial policies must (have to) be handled in ways that will not jeopardize growth. The only permanent solution to all of these problems rests on rapid growth."[1] Some of the most prominent strategies adopted included import substitution, the shift from low to high value export crops, provision of incentives for foreign investment and a commitment to private enterprise.

However, the country's economic fortunes have swung back and forth over the three decades of post-independence. The first decade after independence saw a GDP growth rate of over 7%. Per capita GDP fell during the oil shock period and regained strength during the tea and coffee price boom of the late 70s. The "Kenyan miracle" apparently collapsed with the recession that affected other Sub-Sahara African economies in the mid-80s. In Kenya's case, a number of factors contributed to the decline, namely the droughts of 1980 and 1984, unstable petroleum prices, the collapse of the East African Economic Community and the unstable export prices for coffee and tea, low growth rates in gross investment and budgetary deficits. Kenya lost its place as a medium income country on the United Nations development index and has remained a low income economy since then.

Kenya is nevertheless, the most industrialized economy in the East African sub-region. It maintains a high level of investment, though a large proportion of it is from external sources. GDP distribution by sectors is as follows: services 49%, agriculture 31%, manufacture 12%; industries 20%.[2] Tea, Coffee, tourism and processed petroleum are the

[1]Republic of Kenya (1965)
[2]World Bank (1991)

major foreign exchange earners. Overseas development assistance from bilateral and multilateral sources accounted for 11.7% of GNP in 1989.[1]

Table 7

Target growth rates by sector (% per year at factor cost)

| | 1989-93 | 1988-2000 |
|---|---|---|
| **Non-monetary GDP** | 3.6 | 3.5 |
| **Agriculture** | 4.5 | 5.3 |
| **Manufacturing** | 6.4 | 7.5 |
| **Trade, restaurants & Hotels** | 7.0 | 5.5 |
| **Government services** | 5.0 | 5.4 |
| **Other sectors** | 5.2 | 6.7 |
| **GDP at market prices** | 5.4 | 5.9 |
| **Population** | 3.7 | 3.7 |
| **GDP per head** | 1.6 | 2.1 |

Source: Republic of Kenya (1986) *Sessional Paper no.1; Development Plan 1989-93*

Kenya's official international debt as at the end of 1989 amounted to $5,690 million. Debt servicing currently represents 33.3% of total export earnings. In the years ahead, the country plans to capitalize on the gains of the structural adjustment programme by further restricting public expenditures and boosting the agricultural and manufacturing sectors. Table 7 shows the distribution of targeted growth rates to the year 2000.

## 2.2 Demographic Development

According to the August 1989 census conducted by the National Council for Population and Development, Kenya's population was 21.4 million.[2] Other sources however, projected a population size close to 24

[1]UNDP (1991) *World Development Report 1991*
[2]Republic of Kenya (1991) *Economic Review*

million. According the official census, national population growth rate was 3.34%. Other estimates though put the rate at 3.9%, ranking Kenyans as the highest growing population in the world.[1] By the year 2000 Kenya's population is projected by UNDP to reach 34 million. This is more than a three-fold expansion of population size since independence. Table 8 shows a population size increase from 5.4 million in 1948 to 21.8 in 1987.

Table 8

Population growth 1948 - 1987

| Population (millions) | 1948 | 1962 | 1969 | 1979 | 1987 |
|---|---|---|---|---|---|
| | 5.4 | 8.6 | 10.9 | 19.9 | 21.8 |
| Annual growth rate (%) | 2.5 | 3.0 | 3.3 | 3.8 | 3.7 |
| Life expectancy (years) | 35 | 44 | 49 | 54 | 56 |

Source: Nobbe C. E. et al. (1990)

The Government of Kenya has for long realized that the current demographic development already had started imposing great strain on the ability to provide primary needs to the people like food, fuel, education and employment. Through the National Council for Population and Development, the Government in current programmes is aiming at reducing the rate of population increase to 3%.

## 2.3 Energy Balance

Five energy sources have helped fuel Kenya's development, namely fuelwood, electricity, petroleum coal and ethanol. Kenya is the only country in Africa that maintains a geothermal electricity plant, with a

[1]EIU (1990-1) Kenya: *Country Profile*

capacity of 45 MW. Prospects for the utilization of the abundant solar radiation and wind sources are considerably good. However, the high cost of their development has inhibited their exploitation.

### *2.3.1 Fuelwood*

According to *World Resources 1990-91*, Kenya's current pool of forest and woodland resources amount to 2.36 million hectares of forests and woodlands. The country's original wildlife habitat is estimated to have been close to 5.7 million hectares. About 80% of the total land area is arid or semi-arid (ASAL). 70% of these resources are found within the ASAL regions. ASAL regions are sparsely populated by nomadic pastoral people who, in most cases, do not cut down trees for firewood, but instead gather fallen trees. However, most of the country's charcoal is produced from ASAL lands for use in urban areas as Mombasa and Kisumu. Government and private wood plantations supply less than 10% of total national consumption and have little impact on rural energy needs.

Table 9

Climatic zones, population and wood resources %

| Zone | % of area | (Hec.) | % of pop. | % of wood stocks |
|---|---|---|---|---|
| High potential | 15% | (8516000) | 81% | 20-25% |
| Medium potential | 5% | (2789000) | 9% | 4-50% |
| Arid/semi-arid | 80% | (4561000) | 9% | 70-75% |

Source: Beijer Institute (1984)

Currently, fuelwood is the largest contributor to Kenya's total energy mix. It currently represents 70% of the total delivered energy. In rural areas it is consumed as fuelwood; and in urban areas it is consumed as charcoal.

About 18 million tonnes of wood were consumed in 1990. Of this amount, rural households consumed 10.7 million tonnes or 74%. Another 2.1 million was used by the rural informal industry and the

commercial sector accounted for 1.3 million tonnes. Commercialization of firewood is restricted to rural areas, as charcoal remains the primary source of domestic consumption in urban areas. As the production of charcoal requires an additional investment in conversion technology, the poorer segments of the society tend to burn wood directly for their energy needs. Charcoal utilization, consequently, is urban and more expensive.

Woodfuel provides at least 85% of Kenya's household energy requirement. Firewood and charcoal represent 63% and 10% respectively of aggregate national energy supply.

Table 10

Percentage wood energy demand by sector

| Sector | Fuelwood | | Charcoal | | Total wood demand | |
|---|---|---|---|---|---|---|
| | % | RE | % | RE | % | RE |
| Rural HH | 72 | 9.24 | 37 | 2.52 | 60 | 11.76 |
| Urban HH | 1 | 0.13 | 50 | 3.41 | 18 | 3.54 |
| Industry | 26 | 3.34 | 12 | 0.82 | 21 | 4.16 |
| Institutional | 1 | 0.13 | 1 | 0.06 | 1 | 0.19 |
| Total | 100 | 12.84 | 100 | 6.82 | 100 | 1965 |

Source: Beijer Institute (1984)

### *2.3.2 Electricity*

An increasing proportion of Kenya's energy needs is being met through the exploitation of the country's hydropower resources. Currently the sector is the third largest supplier to the total national energy demand. Total national installed capacity by 1990 was 722.6 MW.

Table 11

Installed capacity of electricity 1986 - 1990 (MW)

| | Hydro | Thermal | Geothermal | Total |
|---|---|---|---|---|
| **1986** | 353.5 | 160.2 | 45.0 | 558.7 |
| **1987** | 353.5 | 176.2 | 45.0 | 574.7 |
| **1988** | 353.5 | 160.2 | 45.0 | 558.7 |
| **1989** | 497.5 | 180.1 | 45.0 | 722.6 |
| **1990** | 497.5 | 180.1 | 45.0 | 722.6 |

Source: Republic of Kenya (1991) *Economic Review*

Total capacity is supplied from hydro (68.8%); thermal (24.9%; and geothermal sources (6.2%). The country's installed capacity increased significantly between 1988 and the present. In the period between 1986 to 1990, production increased by 5.5% annually. With the commissioning of the Turwell Gorge multipurpose project in 1991, capacity was boosted by an additional 106 mega watts.

Power generation has also had an upward development in the past four years. According to Table 12, domestic electricity generation has grown by 32% between 1986 and 1990.

Table 12

Electricity generation 1986 - 1990 (GW)

| | hydro | thermal | geothermal | total |
|---|---|---|---|---|
| **1986** | 1 736 | 202 | 369 | 2 307 |
| **1987** | 1 813 | 267 | 374 | 2 454 |
| **1988** | 2 323 | 198 | 323 | 2 844 |
| **1989** | 2 469 | 109 | 322 | 2 900 |
| **1990** | 2 537 | 171 | 336 | 3 044 |

Source: Republic of Kenya (1991) *Economic Review*

In addition to domestic sources, electricity imports from neighbouring Uganda made up about 20% of Kenya's 3,044 gigawatt hour total national generation of electricity in 1990.

Table 13

Estimated hydropower potential by basins

| **Basin** | **Gross capacity (MW)** |
|---|---|
| **Lake Victoria drainage system** | 258 |
| **Kerio and Ewaso Nyiro** | 158 |
| **Tana and Athi rivers** | 556 |
| **Ewaso Nyiro North** | 155 |
| **Total** | **1127** |

Source: Republic of Kenya (1987) *National Energy Policy and Investment Plan*

There are yet untapped hydropower resources in Kenya. In the *National Energy Policy and Investment Plan,* a total of 1127 MW of electricity could be commercially tapped from the Lake Victoria

drainage system, Kerio and Ewaso Nyiro, Tana and Athi rivers, and the Ewaso Nyiro North basins. (See table 13) When these resources are fully developed, Kenya's dependence on imported energy will be lessened. It will also affect the country's prospective $CO_2$ emission budget.

### *2.3.3 Coal*

There are no proven deposits of coal in Kenya. However, coal imported from Swaziland represent 1% of total energy consumption. Coal is currently providing the source of energy for cement production in Mombasa. Its place could easily be traded for petroleum depending on their relative prices.

### *2.3.4 Petroleum*

Imported petroleum is the largest source of energy in Kenya's modern sector. There are currently no commercially viable oil deposits in the country. Between 1984 and 1989, the consumption of petroleum has gone from 17.28 million tons of oil equivalent to 21.771 million tons oil equivalents. For the past three years (see table 14) petroleum has maintained a 28% share of the total energy consumed in Kenya. Increases have effectively been checked by Government policy to reduce dependence on import oil. Importation for processing and export to other East African countries has become an important foreign exchange earner.

Petroleum imports come basically from the Middle East and refined in Kenya's only refinery in Mombasa. The state has 50% equity in the refinery with the balance shared between foreign investors. The refinery has a capacity of 4 million tonnes per annum and was originally constructed to supply neighbouring Tanzania, Uganda, Zaire and Sudan. Due to operational problems the refinery has not been able to run at full capacity.

A pipeline with a capacity of 5.2 million litres links the refinery with Nairobi. Further extensions are planned to link up with the western parts of the country.

The national oil company, National Oil Corporation of Kenya (NOCK), import 30% of total imports, while Kenya Oil Company (KENOL), the only indigenous private oil company shares the balance with foreign multinationals.

Table 14

Kenya: Energy supply by source 1987 - 1989 (tonnes of oil equivalent)

| Energy type | 1987 (1) | 1988 (2) | 1989 (3) | % change between (1) and (2) | % change between (2) and (3) |
|---|---|---|---|---|---|
| **Woodfuel** | 4695 | 4969 | 5260 | (5.8) | (5.9) |
| (%) | (67.4) | (68.0) | (67.9) | | |
| **Coal** | 82 | 79 | 92 | (-3.8) | (16.5) |
| (%) | (1.2) | (1.1) | (1.2) | | |
| **Petroleum*** | 1980 | 2049 | 2171 | (3.5) | (6.0) |
| (%) | (28.4) | (28.0) | (28.0) | | |
| **Ethanol** | 6 | 6 | 6 | (0.0) | (0.0) |
| (%) | (0.1) | (0.1) | (0.1) | | |
| **Electricity** | 203 | 208 | 217 | (2.5) | (4.3) |
| (%) | (2.9) | (2.8) | (2.8) | | |
| **Total** | **6966** | **7310** | **7746** | **4.9%** | **5.6%** |
| | **100%** | **100%** | **100%** | | |

*Source:* Karakezi et al. (1992) and project generated numbers
*Include LPG, Petrol, Kerosene, Gas oil, Diesel, Aviation Petrol and Fuel oil.

Table 15

Composition of end-use consumption by sector and main fuel type

| Sector | Wood (63%) | Charcoal (8%) | Residue (3%) | Petroleum Products (24%) | Electricity (2%) | Total (100%) |
|---|---|---|---|---|---|---|
| Urban HH | 1% | 50% | - | 5% | 36% | 6% |
| Rural HH | 72 | 37 | 100 | 5 | - | 53 |
| Agriculture | - | - | - | 9 | 10 | 2 |
| Industry | 26 | 12 | - | 24 | 31 | 24 |
| Commercial | 1 | 1 | - | 1 | 22 | 1 |
| Transportation | - | - | - | 56 | 1 | 14 |
| | 100% | 100% | 100% | 100% | 100% | 100% |

Source: Beijer Institute (1984) *Energy and Development in Kenya: Opportunities and Prospects.*

### *2.3.5 Ethanol*

Kenya is one of the few African countries with a commercial exploitation of ethanol. Ethanol is a byproduct of sugar refining in Muhoroni in the western part of the country. Currently, it is blended with gasoline in a 10% proportion. The fuel is mostly consumed in Nairobi.

According to two studies with base years in 1980 and 1989 (Beijer Instuitute 1894; Okech et al. 1992) the pattern of energy consumption in Kenya has not witnessed any major change in the past ten years. Major trends like the continuous dependence of rural people on foodfuel, the transport sector on petroleum, manufacturing, agriculture and commerce on a mixture of energy sources are prevalent.

### *2.3.6 Residential*

The household sector continues to dominate in its share of net national energy demand. Its share of total national consumption is 70%. Biomass also continues to be a poor man's energy alternative accounting for about 95% of the energy needs of rural people. Though the residential sector has maintained similar proportions in the consumption of biomass, in real terms it has grown 6% annually. Charcoal maintains its urban profile while fuel wood is rural. The residential sector depends also on three other forms of energy, including kerosene, electricity and liquefied petroleum gas.

### *2.3.7 Transport*

The transport sector is the largest modern energy user in Kenya and the second-largest in net energy consumption in the country. Petroleum products continue to dominate inputs into the sector. An increasing trend is the role of gas oil has been observed over the years. Ethanol has defended its steady but modest contribution exclusively to the sector.

### *2.3.8 Manufacturing*

The manufacturing sector's share of total energy consumption declined from 18% to 14% between 1984 and 1989. However, in absolute terms its total demand grew between 3% to 5%.

Major sources for energy in the manufacturing sector has been petroleum and woodfuel. 11% of total demand comes from electricity

while 9.2% is represented by coal. Cement, clay, glass and chemical production are the major energy intensive industries.

### *2.3.9 Agricultural sector*

Energy consumption by the agricultural sector offers an interesting perspective. While it remains the largest employer of labour and the highest contributor to GDP, it consumed barely 10% of total national energy demand. Woodfuel features dominantly in the sector.

### *2.3.10 Commercial sector*

Components of the commercial sector include, hotels, hospital, trading, office buildings, etc. This is the least energy consuming sector in the Kenyan economy, representing barely 5% of total energy consumption.

## 2.4 Energy and environmental challenges

As Government's policy on the management of the role of petroleum in Kenya's net energy balance begins to bear fruit, by far the most critical challenges facing energy production, utilization - and in fact, Kenya's national development is deforestation, land degradation and drought. With a growing evidence of increased dryness, Kenya's biomass resources are being put under severe pressure. The task in Kenya, as some scientists have observed, will be the ability to design plans that are capable of guaranteeing energy security and the rehabilitation of land lost due to climate variability.[1] In the short term, increasing the level and efficiency of energy utilization will remain an imperative.

### *2.4.1 Drought, deforestation and land degradation*

Fuel wood maintains its place as the primary energy source for the majority of Kenyans, and more so for the country's rural populations. Factors such as the rate of population growth, natural disasters, recurrent drought and the dependence on biomass for household energy needs, has tended to enhance the mismatch between biomass resources and human needs. Deforestation is currently at the rate of 19,000 ha/year, while reforestation stands at 10,000 ha/year.

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[1]Nasubo G. et al. (1991) *Weathering the storm - Climate Change and Investment in Kenya.*

Only about 15% of the total land area of Kenya is used for intensive agriculture. It was estimated that by the end of the 1980's that Kenya had already lost 71% of its natural forest cover. Of the estimated 8000-9000 species of plants that occur in Kenya, 20-30% might be threatened due to human development activities such as agriculture, industrial infrastructure development and human settlements. These processes have been enhanced by the recurrent drought. Their consequences are catastrophic for food and fuel security.

### *2.4.2 Climate Change*

Cement production, fuelwood and fossil fuel burning are the greatest contributors to $C0_2$ emissions from Kenya. Enhanced warming in the arid and semi-arid zones will likely increase deforestation and decline in the productivity of savannahs and forests. A revolving process of drought, desertification and further pressure on marginal lands will exacerbate further contribution of Kenya to the global buildup of greenhouse gases. This is even more so as Kenya's population remains on the increase.

It is estimated that fuelwood consumption per capita/year in Kenya is close to 0.6 tonnes. At the current population of 24 million, consumption will stand at an annual rate of 14.4 million tonnes. By the year 2000, when population is expected to increase to 34 million, woodfuel demand will be close to 20.4 million tonnes. This represents an increase of 42% based on population growth alone.

Table 16

Comparison of $CO_2$ emissions, tonnes of carbon per person/year: Kenya and the World.

| | Kenya | % | World | % |
|---|---|---|---|---|
| **Fossil fuels** | 0.063 | 22 | 0.96 | 83 |
| **Wood fuels** | 0.215 | 75 | 0.10 | 9 |
| **Cement** | O.0008 | 3 | 0.10 | 9 |
| **Total** | 0.2788 | | 1.16 | |

Source: Hendrick Othieno (1991)

Taking into considerations the absolute increases in the use of fossil fuels envisaged in the *National Energy Policy and Investment Plan* emissions from Kenya might be significant.

In Kenya, the factors that increase the emissions of greenhouse gases also undermine the local energy resource base. Therefore resources spent on curbing emissions from Kenya also go directly to restore local life-support systems.

## 2.5 Policy and Institutions

Energy policy making in Kenya has benefitted from a few externally conceived research programmes. They include the Beijer Institute studies on Kenyan Energy, Environment and Development, and also The World Bank/UNDP Energy Sector Management Support Programme (ESMAP). The government adopted an energy policy in 1987 aimed at increasing national energy self-sufficiency in both commercial and domestic supplies. Kenya's energy policy was sought realized through three major strategies, namely, increasing energy supplies, energy conservation and changing the energy usage mix.

In the years ahead, energy consumption has been projected to increase by 4.4% per annum to the year 2000. In cooperation with

NGOs like the Kenyan Energy and Environment Organizations, donor agencies and the Ministry of Energy projects aimed at increasing supplies are being implemented. A priority area is the development of the country's vast hydro and geothermal potentials. Capacity is expected to rise to 920 MW by the year 2000. In pursuit of a reduced dependence on petroleum imports, prospecting activities is to be intensified. Several forestry programmes are currently being implemented by the Department of Forestry, NGOs like the Green Belt Movement, and external agencies like the United Nations Food and Agricultural Organization.

Excessive reliance on fuelwood for household energy needs and imported petroleum for transportation and industry, have enhanced desertification and an overstrained foreign exchange situation, respectively. Government's long term strategy is to reduce dependence on these two forms of energy. This will be realized through a boosted investment in hydro and geothermal sources. Other renewable sources have also been receiving increasing attention both by the state and NGOs.

Increasing energy conservation through the development and dissemination of improved and efficient renewable energy technologies have also been encouraged. Various NGOs are involved in promoting efficiency in the consumption of household energy, while the Kenya Industrial Energy Management Programme, under the Ministry of Energy promote energy efficiency at the industrial level.

### *2.5.1 The Ministry of Energy*

The Ministry of Energy is the primary institution responsible for the implementation of the country's energy policy. The ministry was established in 1979 and was charged with policy formulation and management of the entire energy sector.

The past few years have seen more emphasis placed on the development of non-conventional energy sources, including, solar, biogas, woodfuel and wind. To increase the level of exploration activities the Ministry has designed attractive fiscal incentives for foreign oil companies. A new Oil Exploration Act changed the basis of operations by foreign companies from licensing out to production sharing. Though some hydrocarbons were found in the Turkana district, commercial reserves are yet to be located. In the electricity

sub-sector, the Ministry is in charge of hydropower development, rural electrification; geothermal power exploration and development. Energy conservation has been one of the most prominent areas of concern. These objectives were to be realized through efficient pricing mechanisms, institutional development, collaboration with agencies and NGOs as well as by encouraging research.

Two major institutional outcomes of the conservation strategy has been the creation of The Kenya Industrial Energy Management Programme (KIEMP) and the Kenya Energy Auditing Programme (KEAP), both are under the Ministry of Energy.

### *2.5.2 The Kenya Industrial Energy Management Programme*

The programme was established by the Ministry of Energy in collaboration with a private sector organization, Kenya Association of Manufacturers. It is designed to assist the industrial sector locate cost-effective measures in energy management. The programme is partly funded by the Canadian International Development Authority.

### *2.5.3 The Kenya Energy Auditing Programme*

The programmes analyzes patterns of energy use and distribution and identifies opportunities for conservation through the provision of technical assistance to industry, commerce and institutions established; it is engaged in the promotion of better utilization; the provision of free energy audits for firms, dissemination of information on energy conservation and the provision of grants for energy conservation feasibility studies by local consultants. The programmes aim at increasing cost-effective energy investments and reducing energy bills through conservation.

### *2.5.4 The Kenya Energy and Environment Organizations (KENGO)*

KENGO has since its establishment devoted its conservation efforts to improve efficiency in the utilization of household energy, especially biomass. In recent years, the organization has built a large international network, both within the East African sub-region and with development agencies through energy research and dissemination programmes.

Other major energy NGOs include the *Foundation for Woodstove Dissemination* (FWD) and the *African Energy Policy Research Network*

(AFREPREN) - all located in Nairobi. AFREPREN is network with members from the 16 countries of East, Central and Southern African countries. The objective of the network is to help strengthen local research capacities and to harness it in the service of energy policy making and planning within the region. *The Green Belt Movement* is a grassroot movement focusing largely on tree planting. The movement has had major successes, especially in creating popular awareness on rural energy and environmental problems.

### *2.5.6 The Ministry of Environment and Natural Resources*

The ministry has the overall responsibility for the implementation of Kenya's environmental policy. It exercises a coordinating role through the Inter-Ministerial Committee on Environment. Its main mandates are environmental protection, forest development, geological survey and research. It is responsible for matters concerning the Intergovernmental Authority on Drought and Development.

### *2.5.7 The National Environment Secretariat*

The National Environment Secretariat is under the Ministry of Environment and Natural Resources and undertakes climate variability and social impact studies, coordination and integration of Government environmental policies, plans, programmes and projects, district environmental profiles, environmental assessment of development programmes and projects, environmental research, education, training and information. It also leads the work of the Inter-ministerial Committee on Environment, combats soil erosion, undertakes trend analyses for population and natural resources. The Secretariat also serves as the UNEP focal point and as a liaison agency with other international organizations.

# 3 Nigeria

## 3.1 Economic Development

Before the discovery of oil, Nigeria's economy was basically agrarian. The export of primary agricultural products like cocoa, rubber, groundnut and palm produce were the backbone of the economy. The economic structure was transformed with the discovery and accelerated development of oil resources leaving agriculture in a state of apparent lull.

Income from oil fueled a tremendous economic growth for Nigeria in the first two decades after independence, representing over 85% of exports and a real GNP rise of more than 150%. The two decades of growth was terminated by recession caused by the plunge in international oil prices during the mid-1980s. As revenues from oil collapsed, Nigeria's import capacity dwindled and the protected small manufacturing sector contracted further. The severely weakened agricultural sector was in no position to cushion the nose diving economic development. Nigeria rolled down from a medium to a low income country in the United Nations statistics.

Economic decline was accentuated by a huge international debt accumulated to finance the development of infrastructures. Government responded to the economic crisis by installing an economic adjustment programme. Helped by oil windfall from the oil price rises during the Gulf Crisis, the programme seems to be paying off in terms of growth.

In 1990 oil represented 97% of total export earnings, increasing by 89.6% from 1989-90. The bulk of non-oil exports was accounted for by the export of cocoa beans. The structure of 1990 GDP is as follows, agriculture 31.6%; petroleum 29.8%; services 26.3%; manufacturing 8.6%; indirect taxes 2.3% and construction 1.4%.

Optimism seems again, to have returned to Nigeria's economic life. Most of the Federal Government Core Industrial Projects are due to come on stream in the 1990s. This includes the huge Liquefied Natural Gas export project, steel rolling mills and the refinery projects.

Table 17

Economic Growth Projections

| | Projected Growth Rate | | Share in GDP (% pa) | | |
|---|---|---|---|---|---|
| | 1985-90 | 1990-95 | 1981 | 1990 | 1995 |
| GDP | 3.5 | 5.0 | | | |
| Manufacturing | 4.0 | 7.0 | 11.0 | 10.0 | 12.0 |
| Petroleum | 3.0 | 3.5 | 14.0 | 14.0 | 14.0 |
| Agriculture | 3.3 | 3.7 | 33.0 | 30.0 | 29.0 |
| Construction | 4.5 | 5.0 | 4.0 | 1.5 | 1.5 |
| Services/Commerce | 1.0 | 4.3 | 38.0 | 44.0 | 44.0 |

Source: Federal Government of Nigeria (1990) *First National Rolling Plan.* Federal Government Printer, Lagos.

According to the Rolling Plan, (table 17) a GDP growth of 5% is expected through to 1995.

Table 18

Fuel Efficiency in major Developing Countries (Km/Liter in1985)

| | |
|---|---|
| China | 10.0 |
| India | 11.0 |
| Korea | 10.0 |
| Indonesia | 10.0 |
| Argentina | 8.0 |
| Brazil | 7.7 |
| Mexico | 5.4 |
| Nigeria | 5.3 |
| Venezuela | 4.4 |

Source: Ketoff A. et al. (1991)

Technological changes have been slow in Nigeria. There is an apparent consensus that the development of indigenous technology, a strategy labelled *africanization*, was not vigorously pursued and therefore did not lead to tangible results. However, oil revenues helped finance new machineries, automobiles and other infrastructure that led to the rise in the demand of commercial energy, especially oil and electricity. An increasing urban population demanded more stoves using liquid petroleum, gas and electricity and thus boosted domestic commercial energy consumption in urban areas. Agriculture remained relatively unmechanized and consumed basically human muscle energy.

Nigeria presently lacks an energy demand management programme. Unlike many other African countries, for example Niger, Senegal, Botswana or Ethiopia where efficient household energy technologies have been vigorously pursued by government and NGOs, Nigeria is yet to make commitments toward energy conservation at household levels. Woodfuel is still burnt in traditional three-stone open stoves with efficiency less than 15%. The transport sector is also energy wasteful compared to other major developing countries. Table 18 shows that except for Venezuela, Nigeria has the lowest level of fuel efficiency in the group.

## 3.2 Demographic Development

Until lately, Nigeria's population was projected at 120 million by United Nations agencies. Things changed with the new report of the Population Commission pitching the number of Nigerians at 88.5 million. This relieved some of the hopelessness that the population issue generated on Government and the development community.

The long term objective of the current national population policy is to curb over-crowding through family planning, the increased inclusion of women in the development process and the development of programmes of population information and communication. However, some studies insist that one of the most efficient ways of reducing population increase is through increasing the literacy rate of women and their general empowerment. Growth in Nigeria's population rate increased from 2.5% between 1965-1980 to 3.4% between1980-87. 43% of the population is under the age of 15.

## 3.3 Energy Balance

Nigeria's energy resources include oil, natural gas, coal, tar sands, hydroelectricity, wood and an abundant level of solar radiation.

Table 19

Nigeria: Energy supply by source 1988 - 1990 (tonnes of oil equivalent)

| Energy type | 1988 (1) | 1989 (2) | 1990 (3) | % change between (1) and (2) | % change between (2) and (3) |
|---|---|---|---|---|---|
| **Coal** | 55520 | 44430 | 38950 | -20.0 | -12.3 |
| ( % ) | (0.4) | (0.2) | (0.2) | | |
| **Hydro Power** | 1052965 | 4320686 | 4636437 | 310.3 | 7.3 |
| ( % ) | (8.0) | (23.0) | (24.5) | | |
| **Natural Gas** | 3334796 | 5939599 | 5873186 | 78.1 | -1.1 |
| ( % ) | (25.3) | (31.6) | (31.0) | | |
| **Petroleum Products** | 8760481 | 8484790 | 8384491 | -3.1 | -1.2 |
| ( % ) | (66.3) | (45.2) | (44.3) | | |
| **Total** | **13203762** | **18789505** | **18933064** | **42.3%** | **0.8%** |

Source: Central Bank of Nigeria (1991)
Conversion: Tonnes of coal =0.70 TOE

### *3.3.1 Oil*

According to the *BP Statistical Review of World Energy, 1991,* Nigeria's total proven reserves of oil amount to 17.1 billion barrels. The Ministry of Petroleum Resources in Lagos however, operates with less conservative reserve figures of about 21 billion barrels. At the current production rate of about 1.8 million barrels a day, reserves could last for the next thirty to forty years.

Currently, Nigeria is planning a boost in production to the 1979/80 levels of 2.4 million barrels a day by 1994. This ambition will tend to

strain the life span of current reserves. Therefore the state is currently designing incentive packages capable of catalyzing further prospecting activities. In addition to traditional areas of prospecting interests, activities have increased around the Lake Chad Basin. There are also plans to include the Upper Benue Basin, the Benue Basin, the Anambara Basin and the Sokoto Basin.[1]

The share of oil in the commercial energy mix has declined from a height of 77% in 1981 to 44.3% in 1990. (See table 19) The decline of oil reflects the growing importance of natural gas in the domestic energy mix. Domestic consumption of liquid petroleum products currently stands at 300,000 barrels per day. This is supplied by the nations four refineries with a total capacity of 450,000 bpd. This capacity is distributed between the old Port Harcourt refinery with a capacity of 60,000 bpd, the new Port Harcourt refinery with capacity of 150,000 bpd, the Warri refinery with 120,000 bpd. and the Kaduna refinery with 110,000 bpd capacities.

Theoretically the country is self-sufficient in refined petroleum products. Nevertheless, these refineries rarely operate at full capacity. The Warri refinery is currently closed down for maintenance and the old Port Harcourt refinery is also shut down because of an explosion and fire outbreak. The two other refineries are not working at full capacities due to one operational reason or the other. A proportion of the country's needs for refined products are currently being imported due to malfunctioning in some of the refineries.

### *3.3.2 Gas*

With the current rate of exploitation, Nigeria's natural gas resources will last for over 300 years. Its proven reserves are officially recorded at 4.6 trillion cubic meters. Associate and non-associated gas put together, will put total reserves at as much as 8.6 trillion cubic meters - three and half time in excess of the total combined reserves available to both Norway and the United Kingdom. When properly developed, Nigeria's production will be a force to reckon with in the international gas market. Meanwhile the first shipment of Nigerian gas to Europe and the United States will take off later in the 1990s.

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[1] Critics charge that exploratory activities in the Lake Chad Basin contains more elements of regional politics than government officials will be willing to concede.

However, of the total deposit in the country, 30% exists as associated gas while the rest is non-associated gas. Meanwhile, Nigeria's vast natural gas reserves are yet to be adequately utilized. The country currently flares about 76% of all associated gas - a quantity much in excess of current North Sea production of natural gas and posing a major threat to international efforts in curbing the greenhouse effect. (See table 24) Nigeria's gas has a high methane component and a low sulphur proportion. This makes it attractive in energy terms and less benign in terms of methane's role in the greenhouse gas build up.

Gas has assumed an increasing role in Nigeria's total energy mix. From a very modest start, gas currently represents about 31% of the total consumption of commercial energy in the country. (See table 19) This is much in tune with the current government's policy to enhance the potentials of the resource, first for export and as such a foreign exchange earner, second, as a catalyst to enhance industrial productivity and third, for domestic use.

Currently, a large percentage of the demand for natural gas comes from the industrial and power generating sectors. This is transported through a network of pipelines, the most elaborate being the Escavos - Lagos pipleline. 4 gas-based export oriented projects are in the pipelines i) Liquefied Natural Gas (LNG), ii) Aluminum Smelting Project iii) Petrochemical (phase II) project and Gas condensates.

A major problem with the gas sector is the low levels of its utilization. 76% of all gas produced in Nigeria is currently flared. This represents a sizable loss of income to the nation as well a substantial contribution to global greenhouse emissions.

### *3.3.3 Coal*

There are huge variations in the estimates of Nigeria's coal reserves. Officials of the Nigerian Coal Corporation estimate that the country's reserves are in the neighbourhood of 1.5 billion tonnes, out of which only 25 million tonnes have been mined. However, the proven reserves today stand at 639 million tonnes. Coal production has been running on an average of 60,000 tonnes per year in the past three years.[1] At the current rate of production, the reserve of coal could last for several hundreds of years.

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[1] Central Bank (1991)

In addition to coal, large quantities of lignite, sometimes referred to as brown coal, exist in Anambara, Imo, Bendel and Benue states. Most of these reserves are of high quality, although some specialized handling equipments are needed in the open mines, as the coal is susceptible to spontaneous combustion and to fragmentation. The exploitation of this resource is yet to commence. It is however believed that their reserves are considerable.

Coal played a prominent role in Nigeria's overall energy mix before the era of an oil economy. However, its current contribution to the overall energy mix has dwindled to an insignificant status of 0.2%. (See table 19 and figure 2).

Coal production has been running into major operational difficulties. Apart from the Okaba mine, there have been major disruptions in the rest of the three mines. It is, believed, however that the Nigerian Coal Corporation has the capacity to boost up production to one million tonnes a year if the investment climate becomes conducive. Among the many difficulties facing the coal industry are the following: price competition from heavily subsidized petroleum prices; the disruptions caused by the Nigerian civil war; the dieselization of the Nigerian railway system; drastically reduced international demand for the country's coal; obsolescence of equipment; the shortage of operating capital; and weakness of government policy.

There are, however, good prospects for the revitalization of the coal industry. A number of key projects within power generation, cement production, iron, steel and aluminum industries are already in the pipelines and can be designed to utilize coal in the years to come. Exports of coal are also likely to pick up soon as discussions with foreign buyers are already underway.

### *3.3.4 Solar Energy Prospects*

On the average, Nigeria receives a solar radiation level of about 5.5KWh per sq. meters. According to Ojosu's calculations, this will amount to $5.081 \times 10^{12}$ KWh of energy per day. If solar devices that have 5% efficiency are used to cover 1% of Nigeria it will be equivalent $2.541 \times 10^{6}$ Mwhs of electricity or 4 656 million barrels of oil per day.

This is 350 times more than the country's current oil production level.[1]

Rural areas presently unconnected to the national grid could have been favoured by the development of this resource base. Nevertheless, efforts are yet to be made by the government or other non-governmental agencies to utilize it.

### *3.3.5 Fuelwood*

According to NEST (1991), Nigeria is losing 350,000 hectares of forests and natural vegetation every year. Over the 1980s, the fastest rate of deforestation in the world was registered in Nigeria - not Brazil, Malaysia or Indonesia. In all 90% of Nigeria's forest resources are gone.[2] These losses have been direct results of energy use, logging and agriculture.

Fuelwood however, remains the dominant primary energy source for Nigeria's rural populations as well as the urban poor. Estimates of both reserves and demands are extremely unreliable. Although biomass currently represents over 60% of the overall national energy mix, government is yet to accord the sector any serious attention. Meanwhile population pressure and deforestation are causing severe scarcities of wood supply to rural and urban residents.

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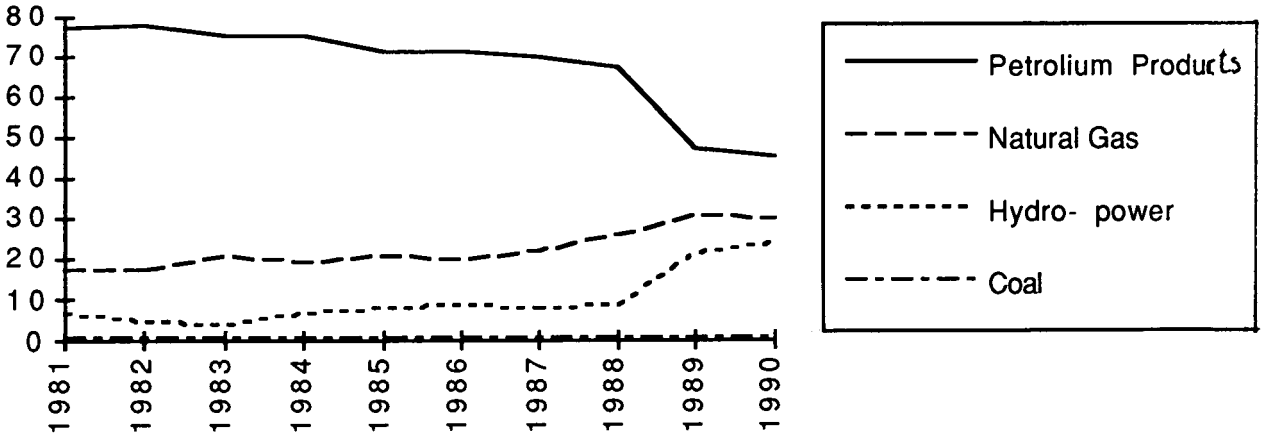
[1]Ojosu, J.O. (1990)
[2]Witte, J. (1992)

Figure 2

**ENERGY CONSUMPTION**
**(Percentage Share of Energy Consumed)**




Source: Central Bank of Nigeria (1991) *Annual Report and Statement of Accounts*

### *3.3.6 Electricity*

Hydro electric power represents 24% of total national consumption of commercial energy. Thermal and hydro sources put together account for close to 40% of total delivered commercial energy in the country. Nigeria through the National Electric Power Authority (NEPA) has a total installed capacity of 6,098 Megawatts supplying an estimated national demand of 2,300 Megawatts of electricity. This is equal to 37.7% of installed national generating capacity of electricity. Electricity is delivered by nine power stations, six of them thermal while three are hydro-based stations. Thermal stations supply over 2/3 of the total delivered energy and are to increase this share on completion of new projects.

In the nearest future, NEPA plans to commission more power stations, for example, the Geregu Thermal Power station and the Zungeru Hydro Power Station with a combined total capacity of 1250 megawatts. Already Nigeria supplies Niamey in Niger Republic and plans are underway to build a transmission line to Maradi. There are also talks

within ECOWAS for a West African interconnection from Nigeria through Benin Republic to Ghana.

However, Nigeria's electricity supply is known to be chronically unreliable. NEPA's dilapidating infrastructure, shortage of skilled manpower and the unavailability of spare parts have resulted in incessant power failures and a poor capacity utilization. As a result, almost all businesses in Nigeria have their own installed generating plants. This has resulted in industrial dislocation and high running costs as well as increased pollution. The latent capacities of these generators are estimated to be over 600 MW in 1986. The World Bank put the cost of running the stand-by generators at over $1,000 annually.[1]

## 3.4 Energy Demand Patterns

Nigeria registered an impressive economic growth in the 70s as a result of the expansion in oil industry activities and the high price of oil in the international market. Windfall from exports helped finance industrial growth and better standards of living. However, besides the direct impact of increased income from oil, high population growth rates and urbanisation accelerated the demand for commercial and traditional fuels. The country's energy demand has grown at a rate of over 13% over the past two decades.[2]

However, this trend reached a peak in 1983 and has since then declined following the structural crisis of the Nigerian economy. Four factors are likely to influence future domestic consumption of energy in Nigeria: i) Following the current policy of economic restructuring, growth has picked up and is expected to continue doing so. ii) Without a radical departure from the current demographic development, increased population may likely raise energy demand, iii) With the renewed optimism in Nigeria's oil and gas industry, prospects are good for increased oil income and iv) the position of the in-coming civilian administration on energy demand management, either through pricing or other institutional mechanisms for improved efficiency and conservation.

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[1] Synge R. (1986) *Energy in Nigeria*
[2] Adegbulugbe, A. O. (1991)

Table 20

Total and sectoral delivered energy demand projections (PJ)

| Sectors | 1985 | (%) |
|---|---|---|
| **Household** | 983.25 | 73% |
| **Industry** | 91.93 | 7% |
| **Transportation** | 258.87 | 19% |
| **Services** | 5.36 | 1% |
| **Agriculture** | 5.77 | 1% |
| **Total** | 1 345.17 | 101% |

Source: Adegbulugbe (1991b)

Energy demand has been growing in all sectors of the Nigerian economy. Patterns of consumption have been slowly changing over the year from fuelwood and coal intensive to a major role for oil and then natural gas. Recent government policies tend to create a role for gas as the domestic fuel of the future, especially in the household and power generation sub-sectors.

### *3.4.1 Household sector*

The household sector is the largest consumer of energy in Nigeria. Biomass remains the dominant energy source for the majority of Nigerian households, accounting for 73% of total energy consumed in 1985. It is known that the traditional three-stone fuelwood stoves generally used in Nigeria are very inefficient (burns at 12-18% efficiency). The rural electrification schemes apparently have not made much impact on rural household biomass consumption since electricity is mostly used for lighting.

Energy needs for urban households are met through fuelwood, kerosene, liquefied petroleum gas (LPG) and electricity. Government has expressed intention to design a package that will encourage the use of LPG in the residential sector.

### *3.4.2 Transportation*

The transportation sector is the second largest consumer of energy in Nigeria. Liquid petroleum takes the largest share of all energy consumed within this sector. The transportation sector will increase its share in all scenarios as long as no determined effort is made by government to design a transport management plan for the big cities, especially Lagos. Over 50% of all the nation's gasoline is used within the Lagos area.

### *3.4.3 Industry*

The heaviest industries are cement production, petrochemicals, steel and electricity generation. Currently, the industrial sector takes the third largest share of total energy demand in the country. Absolute and relative growth in the quantity of energy consumed are to be expected in the years ahead as some of the Federal Government's core projects will be commissioned in the mid-1990s. The Government is planning to fuel as many industries as possible with gas, thereby releasing more oil for exports.

### *3.4.4 Services and Agriculture*

The service and agricultural sectors have not yet been well developed in Nigeria. They consume modest proportions of energy. Electricity is the major supplier to the service sector, while agriculture is still much dependent on biomass for its energy supply.

## 3.5 Energy and Environment Challenges

### *3.5.1 In search of an energy policy*

One of the greatest challenges facing the management of the energy-environment nexus in Nigeria is the complete dearth of a comprehensive energy policy for the country. There is no doubt that Nigeria needs an energy policy that takes into account the interrelatedness of the nations various energy systems, and the economic and social implications of alternative energy paths as well as, the environmental sensitivity of alternative strategies.

The absence of such a policy has weakened attention to given to the already overstressed and disarticulated biomass energy system. Currently representing over 60% of the total national energy mix, the severe pressure mounted on this resource base is accelerating soil

degradation, the frequency of flood, deforestation, desertification and water contamination. In the World Bank study: *Towards the Development of an Environmental Action Plan for Nigeria* (1990), these problems were highlighted as the nation's priority issues. Furthermore, the production and consumption of modern fuels, especially petroleum is causing land and water pollution in oil-producing areas as well as air pollution in urban areas. Meanwhile, climate change as an increasing global concern has also drawn attention to the role of Nigeria's gas flaring in the build of green house gases.

### *3.5.2 Drought and Deforestation*

Nigeria is facing a persistent drought in the arid and semi-arid zones of the northern parts of the country. During the 1969 -73 drought alone, over 300,000 animals representing 13% of the total livestock population of Bauchi, Borno, Gongola states, perished. Under the shadow of international attention to the drought in the Horn and Kalahari regions of Africa, Nigeria was also undergoing a severe drought situation in the marginal lands of the North. With the pressure of human and animal populations on these lands, droughts have become frequent and prolonged. According to estimates by NEST, about 140,000 square kilometers, representing 15% of Nigeria, is afflicted by severe desertification. About 67,255 square kilometers of Sokoto state is said to be under siege, while about 64,123 square kilometers of Borno State is afflicted.[1] Residents of these areas have since experienced harsh scarcities of fuel wood.

The loss of top soil by floods which by themselves are indirectly caused by excessive deforestation is especially severe in the South. Areas around Lagos and the delta region are especially prone to floods, while erosion is especially common in the Eastern states.[2]

### *3.5.3 Pollution*

Pollution of the atmosphere, as a result of inefficient and wasteful fossil energy use, bush and fuelwood burning, urbanization, industrialization, gas flaring, and other human activities, have been

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[1]NEST (1991) *Nigeria's Threatened Environment - A National Profile*

[2]38% of all Nigeria's industries are located in the Lagos area. Cited from NEST (1991).

increasing steadily. Fuel consumption for commercial energy production in the country is capable of

Table 21

Oil spill from 1976 to 1990

| Year | No. of spill | Quantity of spilled (barrels) | Quantity recovered (barrels) | Net volume to the environment |
|---|---|---|---|---|
| 1976 | 128 | 26,157 | 7,135 | 19,021 |
| 1977 | 104 | 32,879 | 1,703 | 31,176 |
| 1978 | 154 | 489,294 | 391,445 | 97,849 |
| 1979 | 157 | 694,117 | 63,481 | 630,635 |
| 1980 | 241 | 600,511 | 42,416 | 558,094 |
| 1981 | 238 | 42,722 | 5,470 | 37,252 |
| 1982 | 257 | 42,841 | 2,171 | 40,669 |
| 1983 | 173 | 48,351 | 6,355 | 41,995 |
| 1984 | 151 | 40,209 | 1,644 | 38,564 |
| 1985 | 187 | 11,876 | 1,719 | 10,157 |
| 1986 | 155 | 12,905 | 552 | 12,358 |
| 1987 | 129 | 31,866 | 6,109 | 25,757 |
| 1988 | 208 | 9,172 | 1,955 | 7,207 |
| 1989 | 228 | 5,956 | 2,153 | 3,803 |
| 1990 | 166 | 14,150 | 2,092 | 12,057 |
| Total | 2,676 | 2,103,006 | 536,400 | 1,566,594 |

Source: Federal Ministry of Petroleum Resources

emitting 44,700 tonnes of dust particles, 1.2 million tonnes of oxides of nitrogen, 5,760 tonnes of oxides of sulphur, and about 73,500 tonnes of carbon monoxide into the air. According to studies conducted by Nigerian scientists, gas flaring in the Izombe flow station in Imo State revealed far-reaching impacts of gas flaring on crop yields.[1]

[1]NEST (1991)

Petroleum production has left a net volume of 1,566,599.21 barrels of crude oil in agricultural and fishing sites between 1976 - 1990. This has often brought the petroleum industry in close confrontation with indigenous communities.

### *3.5.4 Climate Change*

Bush burning, fuelwood and fossil fuel consumption, as well as gas flaring are the major components of Nigeria's contribution to the global build up of greenhouse gases. Out of all these sources, the flaring of associated natural gas represents about 45% of total $CO_2$ emissions from the country.

Table 22

Estimate of $CO_2$ indicators for Nigeria

| | 1985 | 2025* |
|---|---|---|
| **1a. $CO_2$ emission ($10^6$ tonnes of C)**** | 36.9 | 118.2 |
| **b. w/o biomass ($10^6$ tonnes of C)** | 16.6 | 80.4 |
| **2. CO2/capita (kgs of C/capita)** | 384.4 | 372.0 |
| **3. $CO_2$/GDP (kgs of C/US$ 1985)** | 0.468 | 0.29 |
| **4. CO2/primary energy (kg of C/CJ)** | 18.4 | 18.3 |

Source: Adegbulugbe A.O. (1991c)

**Based on a* business-as-usual emission case scenario. It is assumed that no gas is flared by 2025.

** Includes $7.2 \times 10^6$ tonnes of carbon emitted due to gas flaring.

Bush burning either for land clearing, hunting or cultural rituals consume an estimated one third of the more than 60 million hectares of Nigeria's savannah. Annual burning of firewood emits 6.42 million tonnes of carbon monoxide, 87,600 tonnes of hydrocarbons, 40,900 tonnes of oxide of nitrogen and 26 tonnes of benzopyrene.

According to Adegbulugbe's calculations, in the least emission case scenario by 2025, Nigeria's $CO_2$ emissions will increase by at least 150% of the 1985 level. The residential, industry and transportation sectors are the major contributors to Nigeria's $CO_2$ emissions. Forecasts are that population growth and growth in economic activities will be the forces behind $CO_2$ emission increase in Nigeria. However, emission per GDP is expected to decline due mostly to efficiency improvements. Currently energy efficiency per GDP is very low in Nigeria.

Table 23

Top Ten Countries for Gas Flaring (1990)

| Country | Amount of gas flared and vented (Bcm/year) | (% of total gas produced) |
|---|---|---|
| Nigeria | 21 | 76 |
| USSR | 19 | 2 |
| Algeria | 7 | 5 |
| Venezuela | 5 | 13 |
| Saudi Arabia | 5 | 11 |
| India | 5 | 30 |
| Libya | 5 | 31 |
| Indonesia | 5 | 9 |
| Iraq | 5 | 50 |
| USA | 4 | 1 |
| Others | 26 | 3 |
| Total | 107 | 4 |

Source: John B. Homer (1991)

Nigeria is number one on the top ten countries for gas flaring, with an annual 21 Bcm/year emission, representing 76% of total gas produced in the country.

Obstacles to the utilization of Nigeria's gas resources are both technical, commercial and policy related. With the several gas projects by both government and the private sector, an increasing share of the waste will be reduced. Government's 2 kobo tax on every 28 cubic meters of gas flared as anchored on *Decree 99 of 1979* is negligible and irrelevant to the objective of minimizing flaring of associated gas.

Table 24

Volumes of Gas Flared in Nigeria ($10^2$ cf/d)

| Year | Volume | Year | Volume |
|---|---|---|---|
| 1958 | 0. 00 | 1975 | 1.80 |
| 1959 | 0. 01 | 1976 | 2.06 |
| 1960 | 0. 01 | 1977 | 2.11 |
| 1961 | 0.03 | 1978 | 1.98 |
| 1962 | 0.05 | 1979 | 2.66 |
| 1963 | 0.06 | 1980 | 2.38 |
| 1964 | 0.10 | 1981 | 1.66 |
| 1965 | 0.28 | 1982 | 1.49 |
| 1966 | 0. 28 | 1983 | 1.47 |
| 1967 | 0.27 | 1984 | 1.57 |
| 1968 | 0.14 | 1985 | 1.30 |
| 1969 | 0.40 | 1986 | 1.30 |
| 1970 | 0.78 | 1987 | 1.30 |
| 1971 | 1.26 | 1988 | 1.22 |
| 1972 | 1.66 | 1989 | 1.82 |
| 1973 | 2.12 | 1990 | 2.04 |
| 1974 | 2.63 | | |

Source: Homer, J. (1991)

Gas Flared into the atmosphere between 1960-1990, totals 14 x $10^9$ that is 16% of the current proven gas reserves of Nigeria of 87 x $10^9$ cf. Current amount of gas flared stands today above the collective annual

production of natural gas in the North Sea and represents an income loss of 4-5 billion US dollars annually.

## 3.6 Policy and Institutions

The current Federal Government's policy on energy and environment is anchored on the 1989 National Policy on the Environment. However it is to be expected that issues and guidelines relating to energy and the environment will be raised in the *National Energy Policy* under preparation by the Energy Commission of Nigeria.

### *3.6.1 The National Policy on Energy and the Environment 1989*

According to the *National Policy on the Environment*, Nigeria should ensure a balanced mix of various energy types that will be compatible with sound environmental practice, and the reductions of negative impacts of energy production and use on the environment.
Among the strategies proposed in the policy include:

i) encouraging the use of energy forms that are environmentally benign and sustainable;

ii) promoting safe and pollution-free operations in energy production and use;

iii) monitoring and controlling the level of noxious byproduct in energy production and use, such as the emissions of CO, $NO_x$, $SO_2$, $CO_2$, and none methane hydrocarbons, thereby reducing the "greenhouse" effect;

iv) establishing stringent standards of safety in all energy production processes;

v) monitoring oil spill contingency plans, including national, cooperative and company-level plans;

vi) ensuring effective monitoring and assessment of environmental protection programmes in upstream and downstream (exploration, production, refining, petrochemicals,

transportation and marketing) activities in the petroleum industry;

vii) establishing standards for the control of fuel additive with respect to trace elements especial Pb, S, Va and Ni, Cr and Zn;

viii) encouraging reinjection and utilization of produced gases to prevent the adverse environmental impacts of gas flares;

ix) encouraging research and development programmes that promote environmentally sound application of coal as a domestic energy source through the reduction of the ash and noxious chemical content;

x) establishing standards to control the level of exposure of humans to nuclear radiation at mines, power plants and reactors and carrying out periodic audit checks on ambient radiation levels at such environments;

xi) licensing of energy waste disposal sites;

xii) encouraging a multisectoral approach to the monitoring and control of environmental problems associated with energy production and use; and

xiii) promoting and encouraging research in the development of energy resources.

Curiously absent in the policy were any provision on the abatement of environmental implications of the production and use of fuelwood, estimated to contribute over 60% of total national energy needs and over 90% of rural household energy consumption. It is is to be hoped that the forthcoming policy on energy will fill in the rift left by the policy on energy and the environment.

### *3.6.2 Energy Pricing Policy*

Domestic energy pricing, especially oil has been one the most contentious issues in Nigeria's domestic economic politics. The Government seems to be caught in-between domestic pressures, especially from organized labour, and the imperatives of the structural adjustment programme to lift the subsidization of gasoline prices. In

the past, increases in prices had led to general strikes and social unrest.

Currently a liter of gasoline is sold for 65 kobo or 3 cents, at current exchange rates. It is believed that Nigeria through the regulation in gasoline prices is losing close to 5 billion US dollars annually. Perhaps of equal importance to the revenue is the lack of competition between alternative and cleaner fuels, such as natural gas. It is also believed that the cheap prices of gasoline have contributed to fuel the growth in oil consumption without a commensurate increase in GDP.

### *3.6.3 The Ministry of Petroleum Resources*

The Department of Petroleum Resources in the Ministry of Petroleum Resources took over from the Petroleum Inspectorate as the environmental watchdog of the Nigerian oil industry. Among its various duties, the Ministry of Petroleum Resources is charged with

i) developing and maintaining a regular inventory of the country's energy resources, current and projected needs including human resources;

ii) guaranteeing the continuity and adequacy of energy supply in the short, medium and long terms, including appropriate conservation policies;

iii) supplying energy at economically favourable cost in the long term;

iv) giving due and timely consideration to security and the needs for environmental protection of the public and the working population from hazards arising from the exploitation, conversion and utilization of energy;

v) improving and intensifying of the country's technological performance capability in the energy sector consistent with selfreliance and the need to attain economic competitiveness; and

vi) providing a coordinated framework for the implementation of these policy guidelines.

In cooperation with the Federal Environmental Protection Agency, the Department of Petroleum Resource undertakes the organization of the biannual international conference: *The Petroleum Industry and the Nigerian Environment.* The first of these conferences was held in 1979.

### *3.6.4 Energy Commission of Nigeria*

After over three decades of energy-resource led development and thirteen years after Decree no. 62 establishing the Energy Commission of Nigeria, the nation is yet to have a comprehensive energy policy. The Commission began work in 1991 and was charged with the responsibility of the strategic planning and co-ordination of national policies in the field of energy in all its ramifications.

It is expected that the National Energy Policy for Nigeria to be prepared by the Commission will contain policy guidelines on the relationship between energy production, utilization and the Nigerian environment.

### *3.6.5 Federal Environmental Protection Agency*

The dumping of toxic wastes in Koko, a coastal town near Lagos by an Italian firm raised much domestic and international attention and catalyzed the establishment of the Federal Environmental Protection Agency (FEPA) in 1988, the National Council on the Environment and the promulgation of the National Policy on the Environment in 1989.

FEPA was established by *Decree 58 of 1988* to have responsibility for the protection and development of the environment and environmental technology, including initiation of policy in relation to environmental research and technology.

Among the responsibilities assigned to the agency were

i) advising the Federal Government on national environmental policies and priorities and on scientific and technological activities affecting the environment;

ii) preparing periodic master plans for the development of environmental science and technology and advise the Federal Government on the financial requirements for the implementation of such plans;

iii) promote cooperation in environmental science and technology with similar bodies in other countries and with international bodies connected with the protection of the environment; and

iv) cooperate with Federal and state Ministries, Local Government Councils, statutory bodies and research agencies on matters and facilities relating to environmental protection.[1]

FEPA has since been engaged in the preparation of policy guidelines, organizing seminars and workshops, participating in international environmental conferences, etc. In 1991, the agency released the *Guidelines and Standards for Environmental Pollution Control in Nigeria.* The policy guidelines focus primarily on the management of gaseous emissions, noise limitations and solid waste management.

FEPA has also been primarily responsible for Nigeria's participation in the on-going international green diplomacy. With the upcoming UNCED preparations both at the Africa regional level and at the negotiation rounds for climate change and biodiversity, FEPA had been the coordinating agency for Nigeria's delegation. The Agency has published the National Report for the UNCED: *Achieving Sustainable Development in Nigeria.*

### *3.6.6 The National Council on Environment (NCE)*

The Federal Government established the National Council on Environment in 1989 to facilitate co-ordination and cooperation between FEPA and the relevant environmental authorities in the 21 states of the Federation, including Abuja, the capital territory. The council meets at least once a year.

### *3.6.7 The National Resources Conservation Council*

The National Resources Conservation Council (NRCC) was established in December 1989. The council was charged with the formulation of a national policy and coordination of all matters concerning the conservation of habitats, species and natural resources in Nigeria. The council received a high profile status with the President being its chairman. Other members including the Vice-president and ministers of other sectors.

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[1]Federal Environmental Protection Agency Decree 58, 1988.

The NRCC is structured into the following departments: Ecological Services, Biological Resource Development, Planning Research and Statistics, Conservation Liaison and Administration. So far, the council has shown minimum interest for fossil resource conservation.

A few Non-governmental organizations have made their impacts felt on issues relating to the state of the Nigerian environment, however organizations primarily focusing on the interplay between energy and environment are yet in their budding stages.

### *3.6.8 Nigerian Conservation Foundation (NCF)*

NEST was established in 1982 by a group of scientists and citizens. NCF promotes public awareness and action on environmental degradation, helps develop and implement national and local conservation policies and undertake, as well as support local conservation activities on a sustainable basis. The organization is closely linked with the World Wildlife Foundation.

### *3.6.9 The Nigerian Environmental Study/Action Team (NEST)*

The organization was founded in 1987. Among its major objectives is to i) to collect basic data and comprehensive information on the state of the Nigerian Environment; ii) to investigate and assess potential environmental hazards; iii) to analyze patterns of human behaviour, social relations and cultural preferences and their effects on the environment; iv) to stimulate public debate and environmental awareness; and v) to provide public information on and for environmental protection and improvement policies.

In 1991 NEST published the first ever comprehensive report on the state of the Nigerian environment: Nigeria's Threatened Environment. The organization collaborates with a Canadian development agency.

### *3.6.10 Green Environment Movement (GEM)*

GEM is a relatively new environmental NGO. The organization has been organizing public enlightenment seminars and participating in media debates on issues relating to the state of the Nigerian environment. Among the issues GEM intends to pursue is the fight against leaded

gasoline, the creation and preservation of urban parks and the creation of a lobby group for the environment.

# 4 Facing the future

A point that can hardly be over-emphasized is the fact that any attempt to paint a general portrait of the African energy crisis is bound to have a very limited success. All African averages are also misleading as countries of the region vary greatly in energy endowment and use. Within countries exist skewed distributions in the level and form of consumed energy. A common landscape that unites the sub-Saharan African energy scene is, of course, the collective economic disempowerment that the past decade has meant to the region - energy importing and exporting countries alike.

Kenya and Nigeria have recorded high growth rates prior to the 1980's recession. They have also suffered the economic turbulence associated with primary product export-led development strategies. Kenya's economic fortunes fluctuated with international prices of coffee and tea, while Nigeria's economic development vacillated with changes in international oil prices. Meanwhile, both slipped down from being medium income economies on UNDP lists into the group of low income ones.

High levels of demographic change have also contributed to impede economic growth, it has reduced the amount of energy for development and has exacerbated the decline in the sustainability of energy systems.

Despite considerable local differences, there are a few common pointers in the African energy and environment scene. Our perception of these trends may be enhanced by profiling the future growth in energy use in the two cases, the environmental implications, the role of the state in directing change towards energy use for sustainable development and the prospects for international policy coordination.

## 4.1 Meeting Future Energy Needs

One of the common characteristics of the energy balance in Kenya and Nigeria is the steady growth in consumption in the past 4-5 years. In the two countries, increases in the demand for energy has

corresponded with periods of renewed economic growth. However, Nigeria under the peak period of recession, in the 1980s, showed considerable inelasticity of energy consumption to economic decline. In Kenya energy use has increased by an average of 5% between 1987 -1989. This is slightly higher than GDP growth within the same period. While commercial energy consumption soared by 42.3% between 1988 and 1989 in Nigeria (due mostly to the increase in electricity generated from thermal sources), a corresponding GDP rise curiously remained absent.[1] To further underline energy use and GDP insensitivity in Nigeria, the GDP increase of 5.2% in 1990 was achieved despite a growth in energy consumption that was close to zero.

Future growth in energy use seems inevitable in the two countries. The high rate of population increase coupled with inefficient standards of fuel consumption, especially in Nigeria, will tend to propel energy use to greater levels. Most projections have pitched a large increase in both biomass and the commercial fuels.

Table 25

Projected energy demand by fuel type 1985-2000 in Kenya*

| | 1985 | 2000 | Growth rate 1985-2000 (% p.a.) |
|---|---|---|---|
| **Fuelwood** | 14 972 | 23 480 | 3.0 |
| **wood for charcoal** | 8 754 | 17 513 | 4.7 |
| **commercial wood** | 1 077 | 2 588 | 6.0 |
| **biomass** | 1 112 | 2 177 | 4.5 |
| **petroleum** | 2 080 | 3 821 | 4.1 |
| **coal/coke** | 97 | 180 | 4.2 |
| **Electricity** | | | |
| **(Kilowatt hours)** | 2 480 | 6 077 | 6.2 |
| **(Capacity (megwatts)** | 586 | 991 | 3.6 |

*Source:* Naubo, G. W. et al.1991
*1000 Tonnes, except for electricity

[1]Central Bank of Nigeria (1990) Annual Report and Statement of Accounts. See tables 5.1 and 5.16, on GDP growth and energy consumption, respectively.

Increased level of energy demand for Kenya (see table 25) will mean more claims on a constrained foreign exchange situation and will exacerbate the ability of the arid and semi-arid zones to cope with pressure for more biomass production. In all the three scenarios, Nigeria (see table 26) will expect a higher level of growth in energy consumption coming mostly from the household and transportation sectors.

Table 26

Projected energy demand by fuel type in Nigeria 1985-2025

| | 1985 (%) | 2025* (%) |
|---|---|---|
| **Coal** | - | 5 |
| **Oil** | 27 | 39 |
| **Natural gas** | 8 | 25 |
| **Biomass** | 62 | 27 |
| **Hydro** | 3 | 4 |
| | **100** | **100** |
| **Total primary energy supply (PJ)** | **1 482.29** | **6 467.87** |

Source: Adegbulugbe, A. O. (1991c)
*Based on a business-as-usual emission case scenario

Meeting the growing energy needs on sustainable bases in both countries will require large scale investments. In Kenya, opportunities for meeting future energy needs exist in the development of hydroelectricity potentials, intensified exploration for fossil fuels and through agroforestry.

The Kenyan Government and NGOs, like Kenya Energy and Environment Organizations, Green Belt Movement and the United Nations Food and Agricultural Organization have embarked on various

forestry programs. Cooperation has also been initiated between the government, donors, NGos and river basin development authorities in the country. These joint efforts aim at developing the 1127 MW capacity potentials of the Lake Victoria Drainage System, Kerio and Ewaso Nyiro, Tana and Athi and Ewaso Nyiro North basins.[1] The state has also extended fiscal incentives to oil companies to encourage further exploration activities. These are projects that will strain the already austere economic situation in the country.

Since most of the future modern energy needs in Kenya is expected to come from hydro sources, they also offer cleaner environmental prospects. Nevertheless, extending electricity to all Kenyans in the near future is still an overly ambitious expectation. Biomass may still have to play a dominant role. If current drought situations in the country continue, both energy security and environmental integrity will be in serious jeopardy.

The prospects for meeting Nigeria's energy needs sustainably will require allowing a greater role for natural gas and hydropower both for local consumption and exports. Currently, there are huge potentials for the development of both resources.

Nigeria currently consumes a mere one-third of its installed capacity of electricity generation. The poor level of capacity utilization is a result of a dilapidating infrastructure that has been bugged by technical and managerial problems. The government and the World Bank have entered an agreement that will provide $400 million for the revitalization of electricity facilities.

Plans to develop the currently flared 21 billion cubic meters per year of natural gas in Nigeria stand out as the most economic and ecologically profitable future energy investment project in Nigeria. It is also a project that will substantially cut down on the country's current contribution to global warming.

Perhaps, the greatest relief for Nigeria's wood resources may come if government's plan on the domestic utilization of Liquefied Petroleum Gas (LPG) comes to fruition. However, the price for LGP might not stand the competition from alternative fuels including biomass, except

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[1]Republic of Kenya (1991) *Economic Review*

government intervenes by lifting petroleum subsidies as well as setting price tags on wood resources. A business-as-usual scenario in the consumption of biomass will enhance the depletion of Nigeria's savannah and perhaps lead to further incursion into the remaining forest cover.

In all, growth in energy consumption in the two countries will demand large investments from already crisis-ridden economies. It might increase environmental degradation, especially concerning climate change, but it need not be so. Prospects for the development of cleaner energy sources for economic growth are good but the path towards such goals poses great challenges to the economies of these states.

The goals of an environmentally benign energy path for the development of Kenya and Nigeria, as well as for the African region, will therefore demand rational policy options that first and foremost are strongly embedded on the present domestic political and economic situations of these countries. It will also demand robust national policy frameworks capable of responding to opportunities for participation in international policy coordination and cooperation. Meanwhile, a number of international and domestic factors converge at the same time to reshape the traditional role of the state in designing and implementing such policies.

## 4.2 Challenging The Role of the State

The role of sub-Sahara African states as the primary agents for change have been undergoing great transformations since the past three development decades. Likewise, the policy environments within which these states operate have restricted the range of options available to African governments. Purposeful policy prescriptions are therefore bound to take into cognizance the constricted policy environments imposed by domestic factors, such like economic recovery and democratization programs, debts as well as droughts.

The transition to a sustainable energy path for sub-Sahara Africa may have to depend on the reordering of the role of the African state. Currently, international and domestic processes are at work to reshape the relationship between the international system, regional organizations, central governments, ethnic constituencies, interest

groups and the domestic private sector. Of particular interest to sub-Sahara African states are the handling of the debt and drought crises as well as the performance of the economic development and democratization projects. The result of these processes will redefine the role of the African state in giving direction to development efforts, including the management of energy production and use and their environment implications.

### *4.2.1 Debt and drought*

Africa's economic fortunes continued to worsen as the terms of trade of most of the states deteriorated. The futility of the New International Economic Order (NIEO) negotiations and the tokenistic performance of the Lome Conventions on trade between the European Economic Community (EEC) and the African Caribbean and Pacific (ACP) states contributed to deepen *afropessimism*.[1] The hope that a genuine partnership in trade could evolve between the region and the North gave way to the enduring reality of paternalism institutionalized through overseas development assistance (ODA). Perhaps, with the exception of the Nordic countries and Canada, ODA has traditionally been a foreign policy instrument of rich countries in influencing decisions within poorer ones. With Africa's high dependence on ODA, from bilateral and multilateral sources, national sovereignty and vulnerability are issues that have increasingly raised serious concerns. Kenya is apparently a good example of a state caught in the ODA trap. In 1990, 11.4% of total GNP came from ODA sources.[2]

The debt crisis entrenched Africa's poor trade terms and its dependence on ODA. Currently, the debt stock of the region far exceeds the region's annual GNP. With debt service payment claiming close to 40% of total foreign exchange revenue in many countries, appeals for debt relief have always attracted policy reform strings that are not always in consonance with the primary development needs of these countries.[3] The activities of Bretton Woods institutions in these

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[1]The term "afropessimism" was earlier used by Amundsen I. (1992) to describe the mood of fatigue in development theory and *praxis* within the region and among the development research community.

[2]The World Bank (1992) *World Development Report 1992*. Current figures are likely to be higher.

[3]The groups around the Institute of African Alternatives in London and the ECA in Addis Ababa, have represented some of the sharpest criticisms of creditor

regards, have given little room for voluntaristic development strategies.

Energy investments are generally capital intensive and require huge financial outlays. The crises in the economy of Kenya and Nigeria have therefore limited investment options in the energy sector, even those with proven potentials for economic development and sound environmental integrity. The development of hydroelectric power resources in Kenya is a case in point. While 20% of Kenya's electricity needs are met through imports from neighboring Uganda, the country possesses a total estimated untapped hydropower potentials of 1127 MW.[1] The development of these resources would not only have generated growth, but will help reduce dependence on imported petroleum, which in any case, is more environmentally unclean.

The delay in the development of Nigeria's enormous natural gas resource is another example of debt constrained opportunities for economic development and environmental protection. Investments in the gas industry are both capital and technological intensive. It is however, estimated that Nigeria had lost tens of billions of dollars through flaring of natural gas. Meanwhile, the practice of gas flaring is raising local and international environmental concerns.[2]

Sub-Sahara Africa is presently facing drought and famine reminiscent of the 1983-86 crisis. 40 million people in the Horn and Kalahari zones are currently threatened by hunger and starvation. This has weakened the capacity of states to provide primary needs for their citizens. Droughts have also necessitated the dependence on relief agencies and foreign powers. These crises situations have contributed to make already weak states more vulnerable and prone to enhanced legitimacy crisis. The condition has particularly become severe in northern Kenya. Food and biomass production have become

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interests in Africa. See Onimode, B. ed. (1989) *The IMF, The World Bank and The African Bebt. vol 1&2.* Also UNECA (1991) *African Alternative Framework to Structural Adjustment Programs for Socio-Economic Recovery and Transformation.*

[1]Republic of Kenya (1987) *National Energy Policy and Investment Plan.* See also table 13.

[2]After several years of false starts, Nigeria's export-oriented Liquefied Natural Gas project, a joint venture between NNPC, Shell, Agip and Elf has taken off. The first shipment to Europe and the United States are expected by the second-half of the 1990s.

increasingly difficult. Woodfuel scarcities due to drought have also affected northern parts of Nigeria.

### *4.2.2 Democracy and economic development*

The processes and outcomes of two important domestic projects currently underway in Nigeria and Kenya will contribute to shape the capability of the state to manage the interaction between the availability of energy for development and broad environmental concerns. One of these projects is economic, the other is political. The World Bank/IMF sponsored economic Structural Adjustment Programs (SAP) was adopted by these states in the early 1980s, while the wave of political democratization took momentum by the end of the 1980s, and is still raging through most countries of the African region.

Since independence, central governments have been core agents in the economic development process of African states. With the debt crisis and the deteriorating terms of trade, Bretton Wood institutions apparently abrogated to themselves *de facto* authority over the direction of economic development in the region. With the controversial SAP project initiated by these institutions, states were forced to adopt market-based instruments in trade, financial and fiscal policies. So far, about thirty-seven African countries are currently undergoing these economic adjustments.

There is a growing body of literature questioning the development relevance of SAP in Africa.[1] Some have contended that the spread of the programme in Africa has created hostage economies, entrenching dependence rather than interdependence and paternalism rather than partnership between Africa and the global economy. In such a perspective, states have become much more vulnerable to fluctuations in the global economy as well as to the dictates of external creditor institutions, than they otherwise would have been. Perhaps, less

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[1]Some of the most pointed observations include Havnevik K.J ed. *The IMF and the World Bank in Africa: Conditionality, Impact and Alternatives*; UNECA (1987) T*he African Alternative Framework to Structural Adjustment Programmes for Socio-Economic Recovery and Transformation.* Onimode, B. ed. et al. (1989) *The IMF, The World Bank and The African Debt vol.1&2;* Cheru F. (1989) *The Silent Revolution in Africa. Debt, Development and Democracy*; Ofstad A. et al (1992) *Authoritarianism Democracy and Adjustment. The Politics of Economic Adjustment in Africa*

contested is the threat that massive disenchantment with the economic programme by civil societies in Africa is posing to the legitimacy of the state. This has resulted in a situation of active instability and increased sensitivity to state security and defense both in Kenya and Nigeria.

Of equal importance to the economic experiment is the project of democratization. From military rule and one-party dictatorships, Nigeria and Kenya respectively, are currently on various stages of establishing democratic institutions and processes. This change is not unconnected with the decline of communism in the former East block, the end of super power geopolitical rivalry in the region, as well as the conditionalities of creditor and donor institutions.

The change to liberal democratic principles have led to increased pluralism, tolerance and inclusiveness in governance. By breaking the monopoly of state power, political parties, special interest configurations and the private sector have increasingly brought their influence to bear on decision-making. More challenging to state power and cohesion however, is the threat of disintegration as ethnic politics gains vitality under the current dispensation of political pluralism. The ability to democratically manage this dimension of African statehood will likely determine the success or failure of the political project.[1]

The direction of change in sustainable energy investments resulting from the on-going political process is uncertain. However, chances are that development-oriented states will emerge in the region if the present economic and political projects turn out relatively stable political institutions and processes as well as some degree of sustained economic growth. In such an optimistic scenario, an enabling environment for energy policy-making that is growth-oriented and ecologically benign will be created. Conversely, a breakdown of the projects may lead to disintegration and chaos. Under this worst-case scenario, attention and resources may be channeled to short term development needs. Growth in the availability of energy for

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[1]The ruling KANU party in Kenya embraced multi-party democracy late in 1991. Elections are yet to be held, political campaigns, however, have been violent while ethnic cleavages have dominated the electoral process, so far. Nigeria is on the last stage of a three-phase transition to a multi-party democratic order. The outcomes of the programme is nevertheless, highly uncertain.

development and the reduction of energy intensity per GDP may consequently suffer significant setbacks.

### 4.3 The Prospects of a New Domestic Order

In the light of the current disparities in the performance of groups of countries in the Third World, vehement debates are currently going on in the development studies community on the interaction between political institutions and principles and economic performance. In the African context, we are yet to see if democratization or authoritarianism will be an impediment or a necessary condition for economic development, or whether democracy can survive under poverty conditions.[1]

An even more pertinent concern in the current transformation processes in Africa is the relationship between new economic and political systems and the ability to develop sustainably. There are currently no fixed consensus on these linkages. Taking instructions from the experiences of different political and economic systems, for example in cold war Europe, our understanding of the prospects of an environmental benign energy path in Africa's emerging capitalist democracies might prove difficult since such reference points hardly left any enviable environmental records.

Perhaps a fruitful inquest into options for a rational and sustainable energy resource management for the region, may have to transcend the dispute on the dichotomies of democracy versus authoritarianism and capitalism versus central planning. At issue will then be a less ideologically-loaded policy response focusing on the rational utilization of available domestic resources, the designing of optimal institutional solutions, and the advancement of international cooperation. For indeed, there exist ample opportunities for improving sustainable resource management in Africa, within the context of the current

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[1]The interaction between politics and economics is indeed an old debate dating perhaps as early as Rostow. For a review of the new literature, see for example Sørensen G. (1992) *Democracy and Democratization. Processes; Domestic and International Consequences*, Boulder: Westview; Ofstad, A. ed. (1992) *Authoritarianism Democracy and Adjustment. The Politics of Economic Reform in Africa.* The Scandinavian Institute of African Studies; and Toye, J. (1992) *Dilemmas of Development: New Challenges, New Theories?* NFU/CMI Bergen.

constraints imposed by natural disasters, foreign powers and domestic pressures.

### *4.3.1 Policy reforms*

There are substantial rooms for improvement in energy resource availability, domestic environmental protection and enhanced contribution to global efforts in combating the greenhouse effect. Policy instrument like prices, efficiency achieved through demand management, intensified agroforestry and infrastructural maintenance can greatly enhance the achievement of energy security for sustainable growth and contribute to reduce these countries' roles in enhancing the greenhouse effect. The energy policy framework in Kenya and Nigeria vary on a number of these instruments, thereby creating opportunities for cross-country learning and cooperation.

#### *4.3.1.1 Efficiency through pricing*

According to the World Bank, the cornerstone of any energy programme is a pricing system that reflects the economic cost of producing power.[1] In the light of the current ecological problems relating to energy production and use in sub-Saharan Africa, prices should not only be set right to reflect production costs, but they should be required to tell the full ecological truth.

In Kenya, apart from the non-monetized rural woodfuel sector, energy prices reflect to a large extent the cost of their procurement and distribution. This is largely true of coal and electricity. Petroleum product pricing has operated on a differential arrangement according to the government's socioeconomic policy.

All commercial fuels are subsidized in Nigeria. The prices of petroleum products are about the lowest in the world. This may explain the current inelasticity of GDP growth with increased consumption of energy.[2] Low prices of petroleum products have proved to be major

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[1]World Bank (1989) *Sub-Sahara Africa: From Crisis to Sustainable Growth. A Long Term Perspective Study*, page 128. World Bank, Washington D.C.

[2]Central Bank of Nigeria (1990) *Annual Report and Statement of Accounts.* See page 67 and 81.

impediments to the viability of investments in alternative sources of energy, especially natural gas. Without competitively priced petroleum products for domestic consumption, economic justifications for the huge financial requirements of gas development will be difficult. The present price regulation therefore leaves room for policy innovations capable of benefiting both economic and environmental considerations in the country.

Setting prices right might be a first step towards a sustainable energy future. However, energy taxes as a conservation measure may, in the long term, achieve a sizable constituency of proponents, especially in countries like Nigeria, if current efficiency standards continue unimproved.

#### *4.3.1.2 Efficiency through demand management*

Kenya provides an example of an innovative demand management policy implemented through a partnership with the private sector and foreign donors. The model is unique in its approach to implementation, energy savings and environmental gains. The Kenya Industrial Energy Management Programme (KIEMP) is an initiative between the government and the Kenya Association of Manufacturers (KAM). The programme provides industrialists with, among other things, free information on energy conservation measures. Free energy auditing is also available from the Ministry of Energy through the Kenya Energy Auditing Program (KEAP). According to officials of the Ministry of energy, these programs have helped cut down energy bills for many industries and have promoted cost-effective energy investments in the country.

Nigeria's total lack of demand management has promoted energy wastes and environmental degradation. The Federal Ministry of Petroleum Resources has traditionally only focused on energy production and supplies. In view of the huge benefits to both the private sector and the national environmental policy, a comprehensive energy management strategy could be in the interest of the Federal Government. The design of such initiatives may appropriately be handled by the Energy Commission of Nigeria.

#### *4.3.1.3 Infrastructure maintenance and manpower development*

Sub-Sahara Africa's 20 gigawatts installed capacity of electricity is double the current consumption of the region.[1] Demands are generally low in the region, while high maintenance costs and the lack of qualified manpower has been crippling the region's electricity sector. The World Bank estimated that the electricity sector alone will require an investment of about $11 billion by the year 2000.

Redundant capacity is also acute in the petroleum refinery sector. Old and poorly maintained technologies, lack of domestic markets, except for Nigeria, are some of the major problems facing the sector. Countries like Kenya and Cote d'Ivoire have kept their refineries economically viable by developing export markets within their sub-regions.

The challenges posed by the electricity and petroleum refinery sectors should lead to a reappraisal of investment needs in the modern energy sector. Apparently, a balance need to be struck between the establishment of new facilities and the need to revitalize old ones and create the human resource bases for the maintenance of these facilities. On the other hand, the tasks in these sectors also demand both intra-regional and international measures that can contribute to local development efforts as well as promote global environmental benefits. By developing energy cooperation within sub-regions, economies of scale would justify large investments in the energy sector, while international concern over unclean energy technologies in the Third World may prompt financial and technological transfers to these sectors.

#### *4.3.1.4 Agroforestry*

Agroforestry contributes to stem erosion of the top soil, provide future woodfuel and charcoal needs as well as act as sinks for $CO_2$ emissions. Agroforestry is particulary important for Africa's contribution to climate change since increase in emissions from both fossil and

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[1]The region's 20 gigawatts installed capacity is unevenly distributed. Only seven countries have more than 1 gigawatt installed capacities. Nigeria, alone has over 6 gigawatts.

biomass sources due to high human population increases and rapid industrialization are expected in the future.

As the stock of wood further diminishes due to drought and increased human populations in both Kenya and Nigeria, efforts need to be intensified to replenish lost forest and woodland covers. In Kenya, government has vigorously pursued this objective alone and together with NGOs and donors, like the FAO, KENGO and GBM. The plantation of fast yielding species has also been encouraged.

Agroforestry is yet to attract a substantial policy attention in Nigeria. Though the current government policy aims at doubling the nation's 9.6 million ha of forest reserves, there are no concrete indications of a radical response to the current woodfuel crisis, especially in the northern parts of the country. There are moreover, no official policies on woodfuel.

Through some forms of incentives and public enlightenment campaigns, local communities and NGOs could be encouraged to initiate both reforestation and agroforestry programs.

### *4.3.2 Rethinking the role of institutions*

The World Bank sponsored structural adjustment programs in the region have contributed to an ideological revisit to the role of states in development. State power has been dominant in the energy sector in most of the countries of the sub-Saharan Africa - energy importing and exporting ones alike. However, it is increasingly being perceived that tackling some of the environmental challenges, as drought and desertification will demand a regional approach, some will also demand self-management by local communities while others still will rest with the central government.[1]

It has therefore become obvious that local communities, private firms and non-governmental organizations will tend to represent

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[1]These views were succinctly expressed by Inge Amundsen (1992:18). According to him, "some hope for Africa lies with the emerging organizations at the regional level, i.e. more efficient regional groupings that might take over some development tasks from the state. Even more promising are, however, the articulation and organization at the civil society level, and the possible decentralization and diffusion of power emanating from it".

institutional supplements to the traditional roles of the state. This will be much so if the current wind of liberal democracy will blow hand in hand with decentralization, and economic reform with an invigorated but managed private sector development.

However, the leverage of different levels of institutional participation depends to a large extent on the task at hand. Non-governmental organizations, for example have made an impact on the research, development and dissemination of sustainable energy forms.[1] Likewise, the much needed sub-regional energy cooperation seems to have been much easily implemented by NGOs.

Likewise, traditional energy forms such as biomass has tended to be well managed by local communities. Age-long customs and traditions have helped preserve the balance in biomass energy security for local people. In many parts of the region, their efforts have been boosted by the support of NGOs. Despite the obvious importance of biomass to the overall energy needs of the region, central governments have had difficulties in managing this sector. The failures owe much to the urban-bias of Africa's energy development as much as it is symptomatic of the limited legitimacy of states and capability to penetrate into local communities.

However, the activities of NGOs and local communities need to be encapsuled within the framework of a comprehensive energy policy strategy where functions are properly assigned and coordinated. The role of the state structure in designing the overall energy supply and demand management is therefore indispensable. With their monopoly over the power of coercion, African states are left with the responsibilities of enacting and enforcing sound environmental practices.

However, it has been rightly observed that all sub-Saharan African states already have institutionalized vested interests in the continuation of centralized energy planning programs. Thus the

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[1]The Kenya Energy and Environment Organizations (KENGO) is a good example of a successful energy and environment NGO, with good institutional links with the government, regional networks and the international community. The African Energy Policy Research Network (AFREPREN) based in Botswana, and the SADCC Energy Programme are also good steps in the direction of establishing policy cooperation in the energy and environmental sectors.

dominant forces in energy policy-making have for long been the old and well established commercial energy supply agencies, particularly the electric power supply agencies and the national oil companies. Their resistance to institutional reforms cannot therefore, be discounted.

On the other hand, some other energy and environmental issues will be best tackled at sub-regional and regional levels. Three factors make such organizational solutions compelling.

In the first place, Sub-Saharan Africa currently possesses energy resource endowments capable of supplying its regional energy needs. These resources are however, unevenly distributed among countries of the region. For example, Nigeria has an installed electricity capacity of over 6 gigawatts while current domestic demand barely exceeds 2 gigawatts of electricity. An ECOWAS sub-regional electricity grid could help to boost economic development by supplying neighboring states.

Second, most of the countries of the region face similar energy supply and demand management problems and could have learnt from each other's experiences at marginal costs. For example, while energy demand management is yielding both economic and ecological fruits in Kenya, the lack of it is costing Nigerians economically as well as in environmental terms. Nigeria's inefficient utilization of fossil fuels is currently one of the highest among major industrializing countries.[1] Cross-country energy cooperation could have increased the transparency of alternative energy strategies.

Furthermore, many states of the region lie within the same ecological zones and collectively exposed to droughts and desertification. The impacts of climate change may enhance desertification in some regions while increasing precipitation and erosion in others. These are common problems requiring concerted sub-regional solutions. Currently, initiatives like the Permanent Interstate Committee to Combat Drought (CILSS) and the Intergovernmental Authority on Drought and Development (IGADD) are positive and may be consolidated by giving them an energy context.

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[1] See table 18.

Political and economic obstacles continue to frustrate the prospects of sub-regional energy policy coordination and joint ventures, despite the obvious development yields such initiatives could have brought to the region. Though cooperation on energy sector issues such as the development of inter-state electricity grids, oil and gas pipelines, joint exploration for petroleum and joint ventures in research and development have for years been on the agenda of bodies like the ECOWAS and SADCC, not much progress has been made on them. The capital intensive nature of energy ventures has left several proposals unaccomplished. Moreover, financing institutions by focusing exclusively on states, have limited the prospects for transnational cooperation in energy investments.

## 4.4 The Prospects of a New International Environmental Order

Increasing the level of energy use is certainly an imperative in the quest to stem the current economic decline affecting sub-Sahara Africa. However, some energy-deficit countries of the region currently commit 40% of their total foreign exchange earning to energy imports. With no clear signs that the terms of trade between the region and the rest of the world will improve in the near future, the prospects of a sustainable energy future will remain dim. Consequently, polluting technologies will prevail in the energy sector, while biomass utilization will likely increase, undermining the integrity of both local life support systems and the global commons.

The situation in the region demands international partnership to redirect the path to sustainable energy for economic growth. The new Framework Convention on Climate Change may open such windows of opportunities, while a future convention on desertification will be a necessary complement to the former. Currently, however, there is a large disparity between the size of feasible resource flows from these multilateral instruments and the magnitude of energy and environmental problems to be addressed. The impacts of these initiatives demand therefore, some significant degree of guarded optimism.

Some perspectives on international efforts to curb global warming have consistently insisted that Africa, for example, will need measures

that lead to sustainable development, even if there were no $CO_2$-induced climatic change. Accordingly, the fact that such measures will help to limit $C0_2$ emissions is an important bonus for the global community but hardly a primary consideration for African governments and populations (Leach 1990; ECA 1991). However, the good news is that domestic energy strategies that are cost-effective and environmentally benign, more often than not, tend to be compatible with broad global environmental objectives. The triple-barreled effect is such that sustainable energy policies lead to low national energy costs, a sound domestic environment and contribute to global efforts to halt the greenhouse effect.

Africa's role in international policy coordination on climate change will be important for a number of reasons. In the first place, with the continent's 3.0% growth in population, by the year 2025 the region's population will be up by 144.2% of 1985 level.[1] For a lower energy scenario to support a targeted economic growth of about 4-5%, one might need to expand commercial energy to about 5% per annum.[2] Modestly, this may triple per capita modern energy use. According to Leach 1990, with no change in the mix of energy sources, Africa's C02 emissions will increase by 374 MT a year, from 156 to 560 MT by 2005. This is equal to 14% reduction in OECD emission, or a 7% reduction for the world less Africa. Consequently, Africa's prospective modern use could be large enough to matter in terms of $C0_2$ emissions. An optimistic energy case scenario could most probably wipe out some of the most ambitious $C0_2$ reduction targets in other regions.

Furthermore, about 80% of the region's energy needs are met by biomass burning. While the modern energy sector is estimated to release about 156 MT in 1987, it was estimated that biomass burning released about 130-200 MT the same year. As the modern energy sector is expected to raise its share of total energy consumption, potentials for substantial reductions of C02 levels will most likely come from biomass.

Moreover, Africa is losing between 3-5 million hectares of tropical forests each year through deforestation, an area greater in size than the country Togo and larger than several European countries. Should

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[1] *World Resources 1990-91*

[2] World Bank (1989) *Sub-Sahara: Africa From Crisis to Sustainable Development*

this rate of loss continue, tropical forests in Africa will be gone within 60 years. Tropical forests have already almost disappeared in Nigeria, Benin, Togo, Ghana and Cote d'Ivoire. This will have serious implications for the provision of sinks for $C0_2$ and rich diversities in flora and fauna.[1]

There are therefore, three major sources of Africa's contribution to greenhouse gas emissions, especially $CO_2$, namely i) the burning of fossil fuels, ii) woodfuel burning and deforestation and iii) land clearance and deforestation. Designing reduction strategies will necessarily have to be anchored on these three sources.

However, we already know that reduction from the burning of fossil fuels will only be marginally successful as Africa needs to increase the level of the consumption of modern fuels in the years ahead. Nevertheless, the role of increased energy efficiency cannot be discounted.

In many years to come, biomass will remain Africa's major source of energy. It is still unclear how much $CO_2$ is released through the burning of charcoal and woodfuel in the region. It is also uncertain how much net decreases of $CO_2$ in the atmosphere can be brought about by improved combustion technologies in the biomass sector. Restoring degraded forests and savannahs through agroforestry will be rewarding as it will enhance Africa's chances of achieving energy sufficiency, prevents $CO_2$ loss through deforestation and acts as sinks for $CO_2$ emissions from other sources.

Meanwhile, Africans might already have started suffering disproportionately from the impacts of climate change. The current drought in the continent is symptomatic of the severity of the region's vulnerability. This is already having adverse effects on agricultural systems, the availability of biomass and the region's hydroelectric potentials.

In the course of future international efforts to implement the Framework Convention on Climate Change, Africans will need international support to improve development efforts and halt desertification through instruments such like technological transfer,

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[1] Serageldin, Ismail (1990) *Saving Africa's Rainforests*

financial additionality, institution-building, manpower development and research cooperation on various areas of the environment and development *problematique*.

It is self-evident that addressing the global warming challenge will demand a binding partnership between the region and the international community. For Africa's future contribution to be effective, support for Africa's development efforts will be an imperative. On the other hand, for the support of the international community to make meaningful impacts, African countries must be willing to compromise policy and institutional reforms capable of transforming this partnership into tangible results.

## 4.5 An Energy and Environment Contract?

International cooperation on energy and environment may have to evade present conventional lapses in the relationship between African countries and the donor community. Weak implementing agencies, misappropriation of resources and lack of commitment from African public agencies have been formidable impediments to the successes of some international economic cooperation with African countries. On the donor side, arbitrary imposition of narrowly conceived programs, the lack of a long-term commitment and unnecessary middling with internal affairs have been some of the major obstacles to progress.

Taking instructions from the poor performance of resource transfer through ODA resulting from some of these lapses, it is perhaps appropriate to apply new modalities for the implementation of projects supported through new and additional funds spinning off from the Framework Convention on Climate Change. A promising mechanism is the instrument of binding "contracts" between recipient countries or NGOs, implementing institutions and donors.[1]

However, international facilities should also aim at supporting African initiatives at regional energy policy coordination and cooperation. This will enhance the economies of scale and the rational exploitation of

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[1] The concept and modalities of a development contract was earlier proposed by Vraalsen T. et al. (1991) T*owards a "Development Contract". A New Model for International Agreements with African Countries?* CMI Working Paper D 1991: 6.

energy resources within the region. For example, the development of Zaire's massive hydroelectric potentials could go a long way to alleviate South Africa's energy needs as well as boost the foreign exchange situation in Zaire. Through a West African electricity grid, Nigeria should be in the position to supply several countries along the coast with electricity from thermal as well as hydro sources. Such projects will not only pay off in energy terms, but will consolidate the politics of collective self-reliance and economic development.

Environmentally benign energy development contracts could be drawn between financing agencies, countries or group of countries or NGOs, for that matter. It should be designed on a case-specific, long term, development sensitive and with binding obligations between more equal partners. Opportunities for such collaborations exist, especially in the electricity sector, energy efficient technology transfer, the exploitation of solar energy and the modern use of biomass.

Nevertheless, however important these transfers of resources may be, their impacts are bound to be short-term. The paths to Africa's recovery and sustainable development might demand more than hand-outs from wealthy nations. Perhaps, emphases need to be placed on the development of scientific knowledge through increased literacy and scientific education and research. For good policies have always been good clients to scientific knowledge.

The past few years have witnessed a rising learning curve among African governments about the implications of global warming both for the region and the rest of the world. Somehow, there seem to be an apparent correlation between the activities of international scientific communities and the policy sensitivity of issues marking Africa's mobilizations under the United Nations Conference on Environment and Development. However, much like other important resources, there exist an uneven distribution of scientific and policy research capabilities in the world. It is therefore important that the region's energy and environment research capability be strengthened through research cooperation and the establishment of policy-sensitive regional research programs.

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