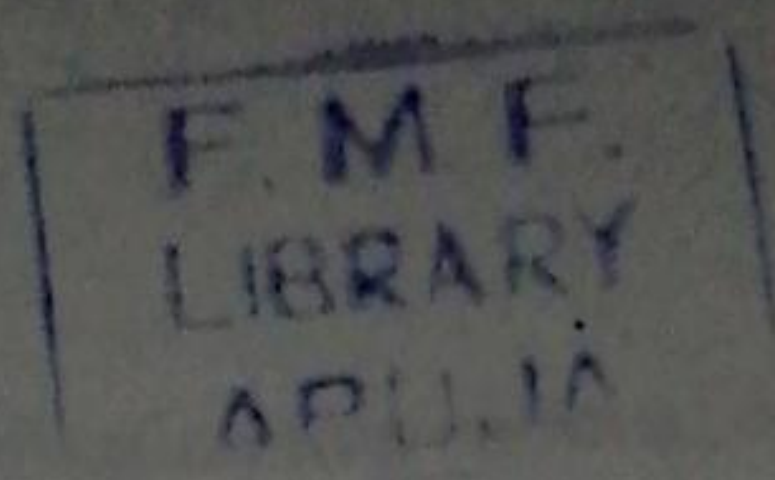




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NATIONAL ENERGY POLICY

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FOREWORD

The nature and extent of energy demand and utilisation in a national economy are to a large extent related to the pace of industrialisation. Therefore, any country that aims to industrialise must give maximum attention to the optimisation of her national energy resources rather than a reliance on imported energy. Indeed, there is often a correlation between national economic problems and heavy dependence on imported energy sources.

It is therefore, clear that every country must put in place a National Policy on Energy that addresses the realisation of a coherent, co-ordinated and cost-effective blue print for the development and utilisation of the energy resources within the country. Moreover, since the exploitation of the conventional energy sources tend to have a measure of negative impact on the environment, such a national policy should promote clean and environmentally - friendly energy practices. Thus, a National Energy Policy should ensure the promotion of a judicious, cost-effective exploitation of the national conventional energy sources, while identifying and harnessing at the same time, alternative and renewable sources of energy.

Also, a National Energy Policy must address the issue of applicable technologies for the local development and manufacture of energy devices and facilitate, in the process, technological advancement as well as industrialisation. Furthermore, it is to be expected that apart from policy objectives that would capture the essence of a nation's energy needs, the policy evolved must incorporate comprehensive strategies for implementation which will take cognisance of the spread and diversity of available energy sources.

In order to come out with a policy document that meets the above stated criteria, the Ministry established, at the instance of the Presidency, an Interministerial Committee and assigned it the responsibility of preparing a National Energy Policy. In carrying out its assignment, the committee was to proceed by appraising a draft policy document prepared by the Energy Commission of Nigeria and was to consult with other Ministries, agencies and institutions, including professional associations, that were considered relevant and important to the evolution and eventual implementation of a National Energy Policy. The document arrived at, therefore, is a distillate of the contributions obtained through consultations at interministerial and specialised committee meetings. The highlights of the Policy Document include a strategy for systematic exploitation of Nigeria's energy resources, the development and effective use of national manpower for exploitation, and a strategy for effective energy funding.

It also incorporates planning and implementation strategies under three broad terms; short, medium, long-term measures.

It is hoped that this document will provide the necessary framework within which contributions to national advancement, from the energy sector of the economy in the context of VISION 2010 and associated plans, will be effectively accommodated.

Major-General

S.I. Momah, mni

Honourable Minister of Science and Technology

Abuja

INTRODUCTION

1.1 Energy has a major effect on every aspect of our socio-economic life. It plays a vital role in the economic, social and welfare development of our nation. Inadequate supply of energy restricts socio-economic growth and adversely affects the quality of life. Improvements in standards of living are manifested in increased food production, increased industrial output, the provision of efficient transportation, adequate shelter, healthcare and other human services. Our future energy requirements will continue to grow with increase in living standards, industrialization and a host of other socio-economic factors. It is pertinent to note that the impact of energy goes beyond national boundaries. Energy supply can be used as an instrument of foreign policy in the promotion of international cooperation and development.

1.2 Socio-Economic Background

The nation's overall economic growth, as measured by the Gross Domestic Product (GDP) has grown by less than 3% annually over the last two decades. In recent years, the GDP has actually decreased. On a per capita basis, the growth has even been less impressive because of high population growth. The population is estimated to be 88.5 million (1991 Census). The population growth rate is over 3%, with a rural population of over 60%.

The general structures of the economy has changed significantly since independence in 1960. Agriculture was the most important sector of the economy, whose contribution to the GDP was above 54%. The contribution of the agricultural sector to the GDP has since declined and is now only a little above 30%. Correspondingly, agricultural exports, which has been the main source of foreign exchange earnings, have declined and food imports have increased from about 13% in 1960 to about 43% in 1991. A closer examination of this increase, however, reveals that the rise is not due to any major leap in industrial development, since the contribution of the manufacturing sector has virtually remained stagnant at about 10% during the period. What industry has gained is primarily due to increases in oil production.

1.3 Energy and the Economy

Nigeria is blessed with abundant primary energy resources. These include reserves of crude oil and natural gas, coal, tar sands, nuclear and renewable energy resources such as hydro, fuelwood, solar, wind and biomass. However, since the late 1960s the economy has been solely dependent expenditures. In 1990, oil revenue alone accounted for over 90% of exports, 80% of total government revenue, with a contribution of about 30% to GDP

The dominant source of commercial energy is oil, accounting for over 70% since the early 1970s, natural gas production, which is mostly in association with oil production, is appreciable. However, about 70% of the natural gas produced is being flared. Up to the early 1960s coal production was significant and dominated the commercial energy supply. It was also the predominant source of energy for rail transportation and electricity generation. However, partly due to fuel substitution to oil and gas, coal production and utilization has dropped to an insignificant level. In 1990, coal's share of the total commercial energy consumption was less than 1%. With respect to the renewable energy resources, hydro power plants entered the Nigerian energy scene in the 1960's, presently hydro is the second largest energy source for electricity generation in the country, contributing about 37 percent of the total installed electricity generating capacity.

Currently, fuelwood accounts for over 50% of overall energy consumption in the country and is the dominant source of energy in the domestic sector. It is also used in other sectors of the economy, such as cottage industries. Over the years the fuelwood supply/demand imbalance in some parts of the country has adversely affected the economic well-being of the people. On the national level, increasing fuelwood consumption contributes to deforestation with consequent desertification and soil erosion.

Solar energy intensity is generally high in the country. Solar energy is widely used in the country for drying, most especially for agricultural products. But it is normally lumped with the informal sector which is not included in the national accounts. Nevertheless, solar energy has great potential for the provision of power for rural development.

1.4 Energy Security

Over-dependence on oil has slowed down the development of alternative fuels.

Diversification to achieve a wider energy supply mix will ensure greater energy security for the nation. The domestic demand for petroleum products is growing rapidly. The development of alternative fuels from locally available energy resources should therefore be vigorously pursued.

The rural populace, whose needs are often basic, depend to a large extent on traditional sources of energy; mainly fuelwood, charcoal, plant residues and animal wastes. This class of fuels constitutes over 50% of total energy consumption in the country. Fuelwood support/demand imbalance in some parts of the country is now a real threat to the energy security of the rural communities. Hence special attention needs to be paid to the diversification of the energy supply mix in the rural areas.

Even when there exists adequate and diversified energy supply options in the country, the problem of unreliability of supply constitutes a huge drain on the national economy. Therefore attention must be given to adequate production levels and a reliable distribution network for all fuel types to ensure steady economic growth.

1.5 Institutional framework

Given the vital role of energy in national development and its impact on every aspect of our life, energy planning must be viewed as an integral part of national development planning such that energy development decisions are not taken as isolated sectoral plans; but rather, closely linked and reconciled with those of the rest of the economy.

A necessary condition for the optimal development of the energy sector is the effective coordination of the various energy sub-sectors because of their interrelatedness. It is also necessary to coordinate the energy related activities of the non-energy sectors of the economy. In this respect, the establishment of the Energy Commission of Nigeria as the governmental organ for the coordination of energy sector activities and the implementation of a comprehensive and integrated energy policy is a major development. This development must however be complemented by promoting cooperation between the Energy Commission and relevant Federal Ministries and other Federal Parastatals such as NEPA, NPC, Nigeria Coal Corporation etc. it is important to realise that in order to increase the efficiency and effectiveness of energy delivery in the country there is a need to develop the technological

capabilities of these parastatals to cope with the challenges of future energy development.

There should also exist at state and local government levels units responsible for energy matters./ these would provide necessary links for the formulation of national energy policies, plans and programmes as well as for the execution of some of the programme. The successful implementation of the energy policy will require the active participation of the private sector. Therefore the input of the organized private sector is essential in the formulation of policy and implementation of strategies.

1.6 Objectives of Energy Policy

The policy objectives and implementation strategies have been carefully defined with the fundamental guiding premises that energy is crucial to national development goals, and that government has a prime role in meeting the energy challenges facing the nation. Furthermore, the dependence on oil can be reduced through the diversification of the nation's energy resources, aggressive research, development and demonstration (R,D & D), human resources development, etc. consequently the overall energy policy objectives may be summarized as follows:

- i. To ensure the development of the nation's energy resources, with diversified energy resource options, for the achievement of national energy security and an energy delivery system with an optimal energy resource mix.
- ii. To guarantee increased contribution of the energy sector to national income and to productive activities.
- iii. To guarantee adequate, sustainable and reliable supply of energy at appropriate costs and in an environmentally friendly manner, to the various sectors of the economy, for national development.
- iv. To guarantee an efficient and cost effective consumption pattern of energy resources
- v. To accelerate the process of acquisition and diffusion of technology and managerial expertise in the energy sector and indigenous participation in energy sector industries, for stability and self-reliance
- vi. To promote increased investments and development of the energy sector industries with private sector participation

- vii. To foster international co-operation in energy trade and projects development in both African region and the world at large.
- viii. To successfully use the nation's abundant energy resources to promote international co-operation
- ix. To ensure a comprehensive, integrated and well informed energy sector plans and programmes for effective development.

Chapter Two

ENERGY SOURCES

2.1 Oil

Crude oil was discovered in commercial quantities in Nigeria in 1956 while oil production started in 1958. The nation has a proven reserve estimate of over 22 billion barrels. The annual oil production peaked at about 840 million barrels in 1979 and thereafter declined to slightly over 600 million barrels in 1990.

Presently, Nigeria has a total installed refining capacity of 45,000 barrels per day. However, capacity utilization is low and consequently the annual consumption of petroleum products is not fully met by internal production and has to be supplemented by imports.

The nation is clearly over dependent on crude oil for its foreign exchange earnings; hence the economy is vulnerable to the unstable nature of the international oil market. Therefore there is a need to promote the expansion of the processing sub-sector to allow for the export of value-added petroleum products. Furthermore, it is desirable to diversify the domestic energy mix away from ever-increasing consumption of petroleum products in order to avert any possible conflict between domestic and export requirement.

Oil will continue to play a major role in the nation's economy, hence the need to expand the reserve base through continuous exploration activities

2.1.1 Policies

- i. The nation shall engage intensively in crude oil exploration and development with a view to increasing the reserve base to the highest level possible.
- ii. Emphasis shall be placed on internal self sufficiency in and export of petroleum products.
- iii. The nation shall encourage indigenous and foreign companies to fully participate in both upstream and downstream activities of the oil industry.

2.1.2 Objectives

- i. To improve the reserve to production ratio
- ii. To adequately protect the country from the vulnerability of oil price fluctuations
- iii. To ensure adequate and reliable supply of petroleum products to meet the demand of the domestic market.
- iv. To derive more economic benefits from the nation's crude oil resources.
- v. To accelerate the process of technology acquisition and diffusion in the oil industry.
- vi. To ensure indigenous capability in such a vital industry to national security.

2.1.3 Strategies

- i. Investing in and intensifying crude oil exploration and production
- ii. Maximizing and expanding the refining capacity in the country to cater fully for local consumption and export of petroleum products.
- iii. Ensuring the establishment of research and development outfits in the country.
- iv. Taking appropriate measures to ensure that Nigerians are put into key decision-making positions in the oil industry.
- v. Providing appropriate fiscal incentives to attract investment and ensure reasonable returns.
- vi. Ensuring the availability of adequate strategic reserves of storage capacity for refined products for at least 90 days of forward consumption.
- vii. Encouraging local engineering design and fabrication of equipment and spares in Nigeria.
- viii. Emphasising the processing of crude oil for export to withstand the adverse effect of crude oil price fluctuations.

2.2 Natural Gas

Nigeria's natural gas reserves estimated at about 164 trillion standard cubic feet are known to be substantially larger than its oil resources. Gas discoveries in Nigeria are incidental to oil exploration and production activities. At present, about 70% of the gas produced (mainly associated gas) is flared.

In view of the increasing domestic oil consumption, an economically optimal strategy to replace oil with gas and gas derivatives will enhance the availability of more oil for export. This will also promote the conservation of the oil reserves. Apart from the economic advantage, fuel substitution from oil to gas is more environmentally friendly because gas is a cleaner fuel than oil.

Given the current reserves and rate of exploitation, the expected life-span of Nigerian crude oil is about twenty five years. It is therefore strategically important to undertake major investments in the gas sector in order to prepare adequately for gas as a substitute for oil both for domestic needs and foreign exchange earnings. The continued flaring of natural gas has resulted in a substantial waste of energy resources, in addition to contributing to atmospheric pollution. It is therefore imperative to take effective measures to curtail gas flaring consistent with the level of domestic gas exploitation and our international obligations with regards to the environment.

2.2.1 Policies

- i. The nation's gas resources shall be harnessed and optimally integrated into the national economy, energy mix and industrial processes.
- ii. The nation shall engage intensively in gas exploration and development with a view to increasing the reserve base to the highest level possible.
- iii. The nation shall put in place necessary infrastructure and incentives to encourage indigenous and foreign companies to invest in the industry.

2.2.2 Objectives

- i. To eliminate the flaring of associated gas.
- ii. To expand the utilization of natural gas as industrial and domestic fuel.
- iii. To increase the use of natural gas as industrial feedstocks for petrochemical and fertiliser plants, etc.
- iv. To use gas to diversify the foreign exchange earning base of the nation.
- v. To accelerate the process of technology acquisition in the gas industry.
- vi. To encourage indigenous entrepreneurial capability in the gas industry including the development of end-use devices.

2.2.3 Strategies

- i. Encouraging the oil producing companies to gather and to utilise associated gas in order to eliminate flaring.
- ii. Imposing appropriate and effective penalties to discourage gas flaring.
- iii. Encouraging the establishment of the necessary infrastructure for the effective gathering, transmission and distribution of gas.
- iv. Providing incentives to encourage industrial and domestic consumers to use gas or to convert to gas.
- v. Subsidizing the cost of LPG appliances in areas not accessible to natural gas so as to encourage the consumer preference for gas.
- vi. Establishing suitable infrastructure for the export of natural gas.
- vii. Ensuring the establishment of gas related R & D outfits in the country
- viii. Formulating suitable urban and regional planning regulations needed for the effective distribution of natural gas to domestic and industrial consumers.
- ix. Providing necessary incentives to indigenous and foreign entrepreneurs to facilitate their participation in the gas industry.
- x. Ensuring that the price of natural gas is cost-effective while giving due attention to the effect on local consumption.

2.3 Tar Sands

Tar sands are known to exist in Nigeria. The deposit is preliminarily estimated to contain a total reserve of about 30 billion barrels of oil equivalent. The heavy crude from the tar sands can be a major feedstock for Kaduna Refinery which refines heavy crude with similar properties that is now being imported.

Bitumen, which is derive from tar sands, is used in road construction and it is also used in electrical, chemical, petrochemical and other industries. If properly harnessed the tar sand resources in the country would contribute immensely to the nation's energy resource base.

2.3.1 Policy

- i. The nation shall encourage tar sands exploration, exploitation and development for full utilisation by the country.

2.3.2 Objectives

- i. To extract heavy oil from the tar sands for refineries
- ii. To conserve foreign exchange used in importing heavy crude oil
- iii. To acquire the technology for harnessing the tar sands.

2.3.3 Strategies

- i. Undertaking exploration activities for tar sands deposits in the country
- ii. Establishing infrastructural facilities for the acquisition of the technology for harnessing tar sands.
- iii. Intensifying R & D in the production of lubricants and other heavy oil products from tar sands.
- iv. Establishing heavy oil upgrading facilities near the tar sands deposits
- v. De-emphasising the importation of heavy crude oil as a way of encouraging the utilization of heavy oils from our tar sands.

2.4 Coal

Available data show that coal of sub-bituminous grade occurs in about 22 coal fields spread in over 13 states of the Federation.

The proven coal reserves so far in the country are about 639 million tonnes while the inferred reserves are about 2.75 billion tonnes.

Coal production in Nigeria started in 1916 with an output of 24,500 tonnes for that year. Production rose to a peak of 905,000 tonnes in the 1958/59 year with a contribution of over 70% to commercial energy consumption in the country. Following the discovery of crude oil in commercial quantities in 1958 and the conversion of railway engines from coal to diesel, production of coal fell from the beginning of the sixties of only 52,700 tonnes in 1983. This excludes the civil war years and the period of 1970 and 1971 during the reconstruction years when there was little or no production.

Production rose to about 100,000 tonnes in 1991, with part of it being for export. In 1980 coal contributed less than 1% to commercial energy consumption in the country as compared to 70% for oil, 25% for natural gas and about 5% for electricity.

Our coal deposits can be utilized for power generation, production of steam and hot air for process heat and drying applications, heat source and reducing agent for steel production, cement production, domestic fuel, source

of chemicals, liquid and gaseous fuels, feedstock for battery, carbon electrode and brick making industries, etc. all the above potentials of coal need to be effectively harnessed into the country's energy delivery system and export commodity mix through the development of a vibrant coal industry.

From the onset of coal production in Nigeria, the Nigerian Coal Corporation had been the only institution active in the coal industry. In 1990 the Federal Government approved the full commercialization of the Corporation. Consequently, joint venture arrangements with foreign partners have developed for the exploitation of some of the coal deposits. There is however the need for increased participation of indigenous companies in the activities of the coal industry.

The nation's coal industry faces some daunting challenges which need to be addressed if the potential for coal utilization is to be optimally exploited. One of the major problems is that of the low productivity of the coal mines and consequently the high cost of production of Nigerian coal. This is mainly due to limited mechanization of the coal mines.

Another problem relates to the lack of cost-effective transportation system for carrying the coal from the mines to consumers far away. Presently the price of coal doubles roughly every 100 km from the mines due mainly to high transportation costs. It is therefore imperative that the present national rail system and port facilities be expanded and made more effective to meet the needs of the coal industry.

2.4.1 Policies

- i. The nation shall continue to pursue vigorously a comprehensive programme of resuscitation of the coal industry
- ii. Extensive exploration activities to maintain a high level of coal reserves shall be carried out
- iii. The exploitation and utilization of the coal reserves shall be done in an environmentally acceptable manner.

2.4.2 Objectives

- i. To promote production of coal for export
- ii. To promote effective utilization of coal for complementing the nation's energy needs and as industrial feedstock.

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- iii. To utilize coal in meeting the critical national need of providing a viable alternative to fuelwood in order to conserve our forests.

2.4.3 Strategies

- i. Intensifying the drive for coal exploration activities.
- ii. Providing adequate incentives for the large scale production of coal stoves at affordable prices.
- iii. Providing adequate incentives to local entrepreneurs for the establishment of coal-based industries
- iv. Developing adequate infrastructure for handling and transportation of coal within and out of the country.
- v. Organizing awareness programmes for the use of smokeless coal briquettes as an alternative to fuelwood.
- vi. Encouraging R & D in the production, processing and utilization of coal.

2.5 Nuclear

Nuclear energy is one of the major sources of base-load electricity generation the world today. The technology for harnessing nuclear energy demands great responsibility and therefore requires careful planning of the manpower development and material resources.

Coordinated approach to research, training and development in the areas of nuclear science and technology in Nigeria started in 1977 when nuclear energy research centres were established in two universities. Thus, the few trained personnel in the areas are concentrated in these two centres. There is therefore an urgent need to accelerate the manpower development programme in view of the diverse peaceful applications of nuclear energy.

Of importance to any nuclear programme is the availability of nuclear minerals such as uranium and thorium. In 1947, pyrochlore containing uranium was found in appreciable quantities on the Jos Plateau and its environs; but there is still no established method of commercial extraction of the uranium. By 1979, about 617,000 km² of land area had been covered by aerial radiometric surveys and another 90,000 km² had been covered by other surveys. At present there are on-going efforts to ascertain the extent of radioactive mineral deposits widely believed to exist in some parts of the country. There is also the need to extend investigations to other areas of the country suspected to have traces of

any of the radio-active minerals and to place the management and all scientific investigations under the control of Nigerians.

Uranium ores are complex assemblages of minerals and therefore differ widely in details of composition and texture. The characterization of the different uranium ore minerals in the country is being carried out. There is however the need to develop the extraction processes for each of them, on the basis of which a commercially viable pilot plant could be established. In addition to the generation of electricity, nuclear energy finds many other peaceful applications. Infact it has been in use in the country for decades for various peaceful applications in health care delivery system, agriculture, food preservation, animal husbandry, pest control, industry and mineral exploration. All these applications will be enhanced by the acquisition of a nuclear research reactor. There is also the need for a law regulating the use of radioactive substances and machines capable of producing ionizing radiation in order to protect the populace from the hazards of radiation.

2.5.1 Policy

The nation shall pursue the exploitation of nuclear energy for peaceful purposes.

2.5.2 Objectives

- i. To pursue the introduction of nuclear power into the generation of electricity
- ii. To apply nuclear science and technology in industry, agriculture and medicine
- iii. To pursue the exploration of nuclear mineral resources in the country.
- iv. To institute nuclear safety and environmental protection measures
- v. To promote the development of nuclear science and technology.

2.5.3 Strategies

- i. Intensifying manpower development in the utilization of nuclear energy for peaceful purposes.
- ii. Evolving appropriate laws and regulations to ensure adequate protection for the public and the environment.
- iii. Intensifying research and development efforts in nuclear science and

- iv. Developing an appropriate institutional framework and infrastructure for the development of nuclear science and technology in the country.
- v. Creating incentives for career development campaigns on applications of nuclear technology.
- vi. Identifying accurately the availability and the extent of nuclear fuels and other materials.
- vii. Providing adequate funding for the development of nuclear science and technology.
- viii. Fostering co-operation with the International Atomic Energy Agency.

2.6 Hydropower

Hydropower is one of the major sources of base-load electricity generation. Despite its high initial capital cost, hydropower provides one of the cheapest and cleanest sources of electricity.

The country is well endowed with large rivers and some few natural falls which are together responsible for the high hydropower potential of the country. The Rivers Niger and Benue and their several tributaries constitute the core of the Nigerian river system which offers a renewable source of energy for large scale (greater than 100 MW) hydropower development. In addition, several scores of small rivers and streams do exist and can be harnessed for small scale (less than 10 MW) hydropower projects.

The total technically exploitable large-scale hydro-power potential of the country is estimated at over 10,000 MW capable of producing 36,000 GWh of electricity annually. Only about one fifth of this potential had been developed as at 1990. The small-scale hydropower potential is however yet to be established. There is the need to develop small-scale hydropower plants for the provision of electricity for the rural areas and remote settlements.

In Nigeria, hydropower generation accounts for a substantial part of the total electricity generation mix. In 1990, hydroelectricity represented over 37% of the total electricity produced nationwide.

2.6.1. Policies

- i. The nation shall fully harness the hydropower potential available in the

- country for electricity generation.
- ii. The nation shall pay particular attention to the development of the mini - and micro hydropower schemes.

2.6.2 Objectives

- i. To increase the percentage contribution of hydro electricity to the total energy mix.
- ii. To extend electrification to rural and remote areas, through the use of mini and micro hydro power schemes.
- iii. To conserve non-renewable resources used in the generation of electricity.
- iv. To diversify the energy resource base.

2.6.3 Strategies

- i. Establishing and maintaining multilateral agreements to monitor and regulate the use of water in international rivers flowing through the country.
- ii. Ensuring increased indigenous participation in the planning, design and construction of hydropower stations.
- iii. Providing basic engineering infrastructure for the production of hydropower plants equipment and accessories
- iv. Encouraging the private sector, both indigenous and foreign, for the local production of hydropower plants and accessories
- v. Ensuring that rural electricity boards incorporate small-scale hydropower plants in their development plans.
- vi. Promoting and supporting R & D activities for the local adaptation of hydropower plant technologies.
- vii. Initiating and updating for the hydropower potential of our rivers and identifying all the possible locations for dams.

2.7 Fuelwood

About half of the world's population depends on fuelwood for cooking and other domestic uses. By 1990 estimates, average daily consumption is about 0.5 to 1 kg of dry fuelwood per person, which is equivalent to 10-20 MJ per day. An average consumption of 10-20 MJ per day solely for cooking may seem

surprisingly large and is due to the widespread use of inefficient cooking methods the most common of which is still an open fire. This system has a very low thermal efficiency.

The rate of consumption of fuelwood far exceeds the replenishing rate to such an extent that desert encroachment is now a serious problem in the country. Also associated with this is soil erosion and loss of soil fertility.

The largest sources of fuelwood at present are from open forests, communal woodlots and private farmlands. Supply from natural forest regeneration is continuously being diminished due to the additional activities such as the clearing of forests for development projects agricultural and industrial activities. Since forests are essential for a healthy environment and as a check on wind and water erosion and desertification, and also serve as energy sources, it is essential that they are cropped on a rational basis.

2.7.1. Policies

- i. The nation shall promote the use of alternative energy sources to fuelwood.
- ii. The use of wood as a fuel shall be de-emphasized in the nation's energy mix.
- iii. The nation shall intensify efforts to increase the percentage of land mass covered by forests in the country.

2.7.2 Objectives

- i. To conserve the forest resources of the nation.
- ii. To greatly reduce the percentage contribution of fuelwood consumption in the domestic, agricultural and industrial sectors of the economy.
- iii. To arrest the ecological problems of desert encroachment and deforestation.
- iv. To facilitate the use of alternative energy resources to fuelwood.

2.7.3. Strategies

- i. Cultivating fast growing tree species needed to accelerate the regeneration of forests.
- ii. Developing appropriate efficient wood stoves in the short term.
- iii. Developing appropriate technologies for the utilization of alternative

- energy sources to fuelwood.
- iv. Encouraging the establishment of private and community woodlots for supply of fuelwood in the short term.
- v. Developing an appropriate pricing structure to encourage substitution from fuelwood to alternative fuel types.
- vi. Ensuring the availability and effective distribution of alternative energy sources to fuelwood at all times.
- vii. Organizing systematic public enlightenment campaigns on the problems of desertification and soil erosion arising from deforestation.
- viii. Ensuring the existence of effective forestry laws to stop the willful felling of trees.
- ix. Ensuring effective enforcement of the forestry laws.
- x. Increasing the area covered by forest reserves.
- xi. Setting up an effective system of forest regeneration.
- xii. Disseminating the alternative technologies to fuelwood through extension programmes, pilot plants e.t.c.

2.8 Solar

Solar radiation is incident on earth at the rate of about 7.2×10^{15} MJ/day. Its intensity varies with location and at a given location, it varies with season, day of the month, time of day, instantaneous cloud cover and other environmental factors. However, the incorporation of efficient storage devices in solar energy conversion systems will take care of this intermittent nature of the availability of solar radiation.

Nigeria lies within a high sunshine belt and, within the country, solar radiation is fairly well distributed. The annual average of total solar radiation varies from about 12.6 MJ/m²-day in the far North. Solar energy is renewable and its utilization is environmentally friendly. Consequently, when the availability and environmental cost of the utilization of other forms of energy are considered, the competitiveness of solar energy in comparison with these other forms becomes very evident, particularly for low to medium power applications.

Solar radiation conversion technologies are generally either of the solar-thermal type (Solar heating, cooling, drying, thermal power plant, etc.) Or of the photovoltaic type (direct conversion to electricity). Areas of application of

solar thermal technologies are crop drying, house heating, heating of process water for industries, hospitals etc, air-conditioning, preservation of foods and drugs, power generation, etc. photo-voltaic (pv) power may be utilized in low to medium power applications and in remote areas, in such uses as communication stations, rural television and radio, water pumping, refrigeration etc, which require power of the order of 1-10 KW. It may also be used for power supply to remote villages not connected to the national grid. It is even possible to generate PV power for feeding into the national grid.

Most solar-thermal technologies can be supported by the technical expertise existing within the country. However the industrial infrastructure needs to be strengthened for effective utilization of the energy resource. Photo-voltaic system components require more sophisticated technologies for their manufacture, particularly as regards the photo-voltaic cells.

Apart from traditional open air drying, solar energy technologies are not much used in Nigeria. Nevertheless they have tremendous potentials. Much work needs to be done in the development and popularization of applications equipment and systems, solar and environmental data acquisition and development of standards for materials, design and equipment manufacture.

2.8.1 Policies

- i. The nation shall aggressively pursue the incorporation of solar energy into the nation's energy mix.
- ii. The nation shall keep abreast with worldwide developments in solar energy technology.

2.8.2 Objectives

- i. To develop the nation's capability in the utilization of solar energy.
- ii. To use solar energy as a complementary energy resource in the rural and urban areas.
- iii. To develop solar energy conversion technologies locally.

2.8.3 Strategies

- i. Intensifying research and development in solar energy technology.
- ii. Promoting training and manpower development.
- iii. Providing adequate incentives to local manufacturers for the

- iv. production of solar energy systems.
- iv. Introducing measures to protect the local solar technology into the energy mix.
- v. Setting up extension programmes to introduce solar technology into the energy mix.
- vi. Providing fiscal incentives for the installation of solar energy systems.
- vii. Setting up and maintaining a comprehensive information system on available solar energy resource and technologies.

2.9 Biomass

Organic, non-fossil material of biological origin is called biomass. The biomass resources of Nigeria can be identified as wood, forage grasses and shrubs, animal wastes and wastes arising from forestry, agricultural, municipal and industrial activities, as well as aquatic biomass. The biomass energy resources of the nation have been estimated to be significant.

Plant biomass can be converted to produce solid briquettes which can then be utilised as fuel for small-scale industries. Biogas digesters of various designs are capable of sustaining household, industrial and institutional energy needs. It has indeed been shown that the remaining biomass material after digestion is a better fertilizer than the original waste. The intensive application of this will reduce the existing heavy reliance on chemical fertilizers.

The abundant energy available from biomass can be meaningfully introduced into the nation's energy mix through the development of a comprehensive programme. The programme should encompass fully supported research, development, demonstration and manpower training components.

2.9.1 Policy

The nation shall effectively harness non-fuelwood biomass energy resources and integrate them with other energy resources.

2.9.2 Objectives

- i. To promote biomass as a supplementary energy resource especially in the rural areas.
- ii. To promote efficient use of agricultural residues, animal and human wastes as energy sources.

2.9.3 Strategies

- i. Developing extension programmes to facilitate the general use of new biomass energy technologies.
- ii. Encouraging R & D in biomass energy technology.
- iii. Establishing pilot projects for the production of biomass energy conversion devices.
- iv. Providing adequate incentives to local entrepreneurs for the production of biomass energy conversion system.
- v. Training of skilled manpower for the maintenance of biomass energy conversion systems.
- vi. Developing skilled manpower and providing basic engineering infrastructure for the local production of components and spare parts for biomass system.

2.10 Wind

Wind is a natural phenomenon related to the movement of air masses caused primarily by the differential solar heating of the earth's surface. Seasonal and locational variations in the energy received from the sun affects the strength and direction of the wind. It is possible to convert wind energy to rotary mechanical energy and electrical energy for a variety of uses. Wind energy has been utilised for centuries for water pumping as well as for the milling of grains. For meaningful exploitation of wind energy, a necessary prerequisite is the optimization of the components of wind water pumping and wind electricity generation.

In view of the energy available in the wind, there is a need to embark on a wind energy development programme.

2.10.1 Policies

- i. The nation shall commercially develop its wind energy resources and integrate this with other energy resources into a balanced energy mix.
- ii. The nation shall take necessary measures to ensure that this form of energy is harnessed at reasonable cost in the rural areas.

2.10.2 Objectives

- i. To develop wind energy technology in areas where it is technically

- feasible.
- ii. To use wind energy for provision of power to rural areas and remote communities far removed from the national grid.
- iii. To develop wind energy to supplement other energy resources.

2.10.3 Strategies

- i. Encouraging research and development in wind energy utilization
- ii. Developing skilled manpower for provision of basic engineering infrastructure for the local production of components and spare parts of wind power systems.
- iii. Intensifying work in wind data acquisition and development of wind maps.
- iv. Training of skilled local craftsmen to ensure the operation and maintenance of wind energy systems.
- v. Providing appropriate incentives to producers and consumers of wind power systems.
- vi. Developing extension programmes to facilitate the general use of wind energy technology.

11.0 Other Renewables

Other renewable energy resources, which are not in common usage worldwide, include ocean waves, tidal energy, ocean thermal gradients, geothermal and hydrogen energy. There is still much more work to be done on these energy resources in Nigeria. They may in future make contributions to the energy mix of the country.

Chapter Three

ENERGY UTILIZATION

3.1 Electricity

Electricity is a form of energy, which enjoys considerable and diverse applications because of its flexibility, and ease of transmission and distribution. Availability of electricity remains a major factor in the location of industries and a strong instrument of social development. Its supply is however still inadequate in the country.

Commercial electricity is generated mainly from hydropower, steam plants and gas turbines in Nigeria. The installed capacity for electricity generation has almost quadrupled in the last two decades and by 1992 it stood at about 6,000MW while only about 3,680 MW was available to the national grid. Over the years the availability varied from about 30% to 60% of the installed capacity. Besides, transmission and distribution (T&D) losses account for about 28% of the electricity generated.

The annual consumption of electricity has been increasing very rapidly over the last two decades. It increased from 1,148 GWh in 1970 to 7,854 GWh in 1990. This however represents a suppressed demand caused by inaccessibility to the national grid and inadequacies of the electricity supply. One consequence of this is that various industries and other consumers have installed generators whose total capacity is comparable to the installed capacity of the national grid.

In recent times, the domestic sector has accounted for about 50% of the grid electricity consumed in the country while the commercial and industrial sectors have accounted for about 25% each. In view of the ever-increasing demands for electricity in the country, there is a need to increase substantially the available installed capacity, and also decrease transmission and distribution losses.

3.1.1 Policies

- i. The nation shall make steady and reliable electric power available at all times at economic rates for economic, industrial, and social activities of

- the country.
- ii. The nation shall continue to engage intensively in the development of electric power with a view to making reliable electricity available to 75% of the population by the year 2020.
- iii. The nation shall encourage private sector participation in the electricity subsector.

3.1.2 Objectives

- i. To provide electricity to all state capitals, local government headquarters as well as other major towns by the year 2010.
- ii. To stimulate industrialization in the rural areas in order to minimize rural-urban migration.
- iii. To provide reliable and stable power supply to consumers, especially to industries.
- iv. To ensure the removal of bottlenecks militating against the utilization of the full capacity of the existing electric power plants.
- v. To broaden the energy options for generating electricity.
- vi. To attract adequate investment capital for the development of the electricity industry.

3.1.3 Strategies

- i. Rehabilitating existing power plants in order to derive optimum power plants in order to derive optimum power from the installed capacity.
- ii. Completing on-going projects designed to enable the National Electric Power Authority (NEPA) satisfy the national demand.
- iii. Reinforcing the transmission and distribution networks necessary to allow consumers to enjoy steady and reliable supply of electricity.
- iv. Establishing basic engineering infrastructure for the local manufacture of electrical equipment, devices and materials.
- v. Encouraging research and development in the generation, transmission and distribution of electricity.
- vi. Reducing high import duties paid on generation, transmission and distribution materials.
- vii. Setting up a National Electricity Supply Training Institute and zonal training centres where the core of the middle level manpower and

- artisans, various cadres of professional technical officers, operators, linesmen and cable joiners are to be trained and groomed in the art of operation and maintenance of equipment for the generation, transmission and distribution of electricity.
- viii. Ensuring the participation and involvement of indigenous engineers and applied research groups in the execution of on-going and future projects right from feasibility studies, with the objective of establishing local capability in the long term.
 - ix. Developing and implementing a programme for the participation of the private sector in the various sectors of the electricity industry.
 - x. Developing other potential sites for hydropower, gas and coal-fired power plants for electricity generation.
 - xi. Intensifying the national effort in training, research and development with a view to generating electricity using nuclear, solar, wind and other renewable resources in order to conserve our fossil fuels.
 - xii. Taking effective measures to ensure the security of electrical installations.
 - xiii. Providing appropriate incentives to entrepreneurs to ensure adequate returns on investment.

3.2 Industry

The industrial sector is one of the major energy consuming sectors and it accounts for over 15% of total commercial fuels currently consumed in the country.

To sustain the expected fast pace of industrialisation in the future, reliable and appreciable supply of energy will be needed by Nigerian industries. The considerable energy resource base of the country is enough to satisfy the industrial energy demand under any plausible scenarios in the foreseeable future. The varied nature of the energy resource base allows for considerable flexibility in energy mix options.

3.2.1 Policies

- i. The nation shall ensure that an adequate supply of energy is made available to meet the full requirements of industrial activities.
- ii. Emphasis shall be placed on local sourcing of all the energy types to the

used by industries.

- iii. Optima utilization of the nation's available energy types for the various industrial activities shall be pursued.

3.2.2 Objectives

- i. To encourage maximum capacity utilization by industries.
- ii. To ensure national security and self reliance.
- iii. To ensure a balanced mix in the use of the nation's energy resources.
- iv. To ensure long term availability of the nation's energy resources through the encouragement of energy conservation practices.
- v. To ensure overall development of the nation's energy resources.
- vi. To promote the efficient utilization of all energy types in industrial activities.
- vii. To use energy in such a manner as to ensure minimal negative environmental impact.

3.2.3 Strategies

- i. Establishing a data bank on energy supply, demand and consumption in the industrial sector.
- ii. Intensifying R & D efforts to determine the appropriate energy types for different industrial applications.
- iii. Establishing institutional arrangement to encourage energy conservation and efficient use of energy in industries.
- iv. Providing adequate incentives to encourage industries to switch over to more appropriate energy types.
- v. Restricting the establishment of industries based on imported energy sources.
- vi. Ensuring strict compliance with energy related environmental pollution standards.
- vii. Ensuring the development of appropriate energy inputs for small scale rural industries.

3.3 Agriculture

Nigeria is an agrarian country and up until the 70s, the agricultural sector formed the backbone of the nation's economy. Most Nigeria farmers, who

produce over 80% of the food needs of the country, live in the rural areas with little access to electricity and petroleum fuels and therefore rely mainly on manual techniques and solar energy in executing most pre-and post-harvest agricultural operations.

In developing an energy policy framework for the agricultural sector, the socio-economic status of the key players in the sector (i.e rural farmers) as well as the energy conservation parameters have to be in proper focus. However, the growing energy needs of large-scale mechanised agriculture should also be considered.

Advances and current knowledge in key areas of nuclear, solar and other energy resources as applied to crop and animal production, forestry, fisheries, food science and technology are not well developed in this country. There is therefore the need for the formulation of a well articulated agricultural energy development strategy which will achieve food security, using techniques offered by nuclear science and other energy resources. It should also address capacity building in energy science with rational management of available Nigeria and material resources and the protection for the environment.

3.3.1 Policies

- i. The nation shall ensure adequate and reliable supply of energy to the agricultural sector.
- ii. The nation shall ensure that appropriate sources of energy are utilised judiciously for the overall agricultural activities with minimum harm to the environment.
- iii. The nation shall emphasis the use of affordable, adaptable, reliable and sustainable agricultural technologies possessing flexible energy utilisation capabilities.

3.3.2 Objectives

- i. To increase agricultural productivity and efficiency through the use of appropriate energy sources.
- ii. To exploit alternative sources of energy thereby minimising the heavy dependence on electricity and petroleum in the total energy mix of the agricultural sector.
- iii. To enhance the productive capacity of rural farmers who mainly rely on

- iv. the cumbersome manual methods of farming.
To develop and promote technologies that would be flexible in their energy requirement.

3.3.3 Strategies

- i. Supporting research and development activities for the evolution of appropriate technologies that can use available/multiple energy sources, including renewable energy sources.
- ii. Developing improved crops, and selecting for breeding such animals as buffalo, donkeys, horses, camels and bullocks that are adapted to different agro-ecologies and that can be used in animal traction.
- iii. Ensuring wider adoption of animal traction and developing simple agricultural machines that can use multiple energy sources.
- iv. Disseminating the developed technologies through extension programmes in the farming communities.
- v. Training the existing extension personnel in effective dissemination of the newly developed technologies
- vi. Ensuring adequate supply of energy for agricultural activities through the application of cost-effective measures, including incentives where necessary
- vii. Promoting the use of renewable energy resources for agriculture.
- viii. Establishing a databank on energy demand, supply and consumption in the agricultural sector.

3.4 Transport

The transport sector, especially the road transport mode, accounts for the bulk of the nation's petroleum products consumption. This pattern in the nation's energy consumption is expected to continue. Furthermore, increased needs for road transport services contribute significantly to the higher energy consumption in the transport sector. The consequence of the above is increased pressure on the nation's available petroleum products and the need to ensure adequate and sustainable availability of these products, as well as strategies to harness alternative energy sources.

Fortunately, the nation has identified other alternative energy options such as natural gas, coal and electricity, which can be introduced into the

transport sector. These measures should be augmented with other cost-effective strategies that will cut down on the demand for oil products.

3.4.1 Policies

- i. The nation shall vigorously pursue the development of an optimal energy mix for the transport sector.
- ii. The nation shall ensure regular and adequate availability of all fuel types for the transport sector.

3.4.2 Objectives

- i. To establish a rational utilization of available energy types for various transport applications.
- ii. To promote a reliable and efficient use of energy with minimal negative environmental impact.
- iii. To promote adaptive technology in energy utilization in the transport sector.
- iv. To promote efficient and reliable operation of the transport sector so as to enhance economic growth.

3.4.3 Strategies

- i. Establishing a data bank on the energy consumption pattern of the transport sector.
- ii. Encouraging the use of diesel for commercial and mass transit transportation while petrol shall be preferentially used for private transportation.
- iii. Pursuing vigorously the introduction of compressed natural gas to the rail and road transport systems.
- iv. Maintaining adequate stocks of various transport fuels at levels that will ensure internal fuel security.
- v. Encouraging a shift towards more energy efficient transportation systems.

Chapter Four

ENERGY ISSUES

4.1 Environment

The major environmental problems related to energy production, distribution and consumption in the country are mainly deforestation and pollution. From available statistics, the nation's 15 million hectares of forest and wood and reserves could be depleted within the next fifty years. These would result in negative impacts on the environments, such as soil erosion, loss of biodiversity, micro-climatic change and flooding. Most of these impacts are already evident in different ecological zones in the country, amounting to huge economic losses.

Pollution is the other major environmental concern. Combustion of fossil fuels, especially in the transport and industrial sectors, contributes greatly to air pollution in our major cities. Another source of air pollution is the continued flaring of large volumes of natural gas in the oil fields in the Niger Delta.

In addition to air pollution, there is substantial water and soil pollution occurring due to oil spillage during oil production and transportation. Over the years, oil spillage has had significant adverse impact on fisheries and marine life in the oil producing areas.

As a result of these possible negative impacts there is a need to incorporate environmental considerations into the nation's energy development and utilization.

4.1.1 Policy

The nation's energy resources shall be exploited in an environmentally safe and sustainable manner.

4.1.2 Objectives

- i. To ensure that in the course of producing, processing, transporting and utilising energy, the environment is adequately protected.

4.1.3 Strategies

- i. Strengthening the relevant regulatory agencies in order to ensure the enforcement of appropriate set standards
- ii. Ensuring monitoring of vital environmental parameters in the production, processing and utilization of energy.
- iii. Carrying out environmental impact assessments of major energy projects.
- iv. Providing viable alternatives to fuelwood in order to minimize deforestation and decelerate the rate of desert encroachment, erosion and deforestation.
- v. Utilizing appropriate technology in the exploitation of the various energy resources to minimize the harmful effects on the environment.
- vi. Encouraging R & D in the optimal utilization of various energy sources to minimize the associated adverse environmental impacts.
- vii. Encouraging the utilisation of environmentally friendly energy sources.

4.2 Energy - Conservation

Presently, energy utilization in our national economy is far from efficient. Apart from direct losses, using energy inefficiently has three major implications to the national economy, namely, investments in energy supply infrastructure in excess of what is required with more efficient equipment and practices; increased environmental problems, and increased cost of goods. The potential for energy savings in the Nigerian economy is huge, especially in the three main energy demand sectors, namely household, industry and transportation. In the household sector, there is considerable energy loss due to inefficient traditional three-stone stoves, used for cooking mainly in the rural areas.

Similarly, there is considerable scope for energy conservation in the Nigerian industries. Energy audit studies have shown that as much as twenty five percent of industrial energy can be saved through simple housekeeping measures. Also, our transport sector has substantial opportunities for savings, most especially the road transport sub-sector.

It is therefore imperative to promote energy conservation and efficient energy utilization in all sector of the economy.

4.2.1 Policies

- i. Energy conservation shall be promoted at all levels of exploitation of the nation's energy resources.
- ii. Energy utilization shall emphasize the development and adoption of energy efficient methods.

4.2.2 Objectives

- i. To ensure the prudent exploitation of the nation's non-renewable energy resources.
- ii. To enhance energy security and self-reliance
- iii. To reduce the cost of production of energy-dependent goods and services.
- iv. To reduce adverse impacts of energy utilization on the environment.
- v. To increase the proportion of hydrocarbon resources available for special applications such as industrial feedstock and for export.

4.2.3 Strategies

- i. Ensuring strict adherence to the regulations of the petroleum industry, and relevant agencies on energy resource exploitation and environment.
- ii. Providing institutional arrangements for the promotion of energy conservation and the use of energy efficient methods.
- iii. Developing building codes so that buildings are designed to take advantage of climatic conditions in order to reduce energy consumption.
- iv. Encouraging the development and manufacture of the more energy efficient equipment and machinery.
- v. Reducing energy consumption by improving and expanding mass transportation and communication systems all over the country.
- vi. Promoting R & D activities in energy conservation and fuel efficiency including the development and importation of energy efficient equipment and machinery.
- vii. Encouraging the production and use of improved and more-efficient cooking stoves.
- viii. Taking appropriate measures to reduce energy storage, transmission and distribution losses.
- ix. Promoting public awareness about the benefits of improved energy efficiency.

4.3 Research, Development and Training

The crucial dependence of the sustainable socio-economic advancement of any nation on research, development and training activities is now universally acknowledged. This dependence is applicable also to the development of vital sectors of the national economy, including the energy sector. For this sector therefore, it is important that research, development and training are given adequate attention with regards to key issues such as energy resources development and utilisation.

4.3.1 Policies

The nation's energy resources shall be developed and utilised on a self-sustainable basis through research, development and training.

4.3.2 Objectives

- i. To initiate and promote energy related research and development programmes; and ensure that such programme are applications - oriented and market driven.
- ii. To promote participation in research and development by Nigerians in all areas of energy exploration, development and utilization.

4.3.3 Strategies

- i. Developing and promoting local capability in the nation's Energy Centres and Research Institutes for the design and fabrication of efficient energy devices and technologies for the utilisation of renewable energy resources.
- ii. Promoting the demonstration and dissemination of renewable energy devices and technologies for their adoption and market penetration.
- iii. Monitoring and assessing international technological developments in all energy areas; and initiating and sustaining local capability for their applications in all sectors of the economy.
- iv. Initiating and promoting energy educational programmes and research activities in tertiary institutions and research institutes.
- v. Encouraging result oriented research and development in the energy sector by making expenditure on such efforts tax deductible, as may be determined by the Federal Ministry of Science and Technology.

4.4 Bilateral, Regional and International Cooperation

Nigeria is involved in bilateral, regional and international arrangements in the areas of energy within the framework of its economic relations with other countries and multilateral institutions. This collaboration is designed to complement domestic efforts towards energy security for the nation. Energy supply, joint management and equity participation in the development of energy sources are important aspects of our bilateral cooperation arrangements with other African Countries.

The nation's membership of sub-regional, regional and international organisations such as ECOWAS, APPA, OAU, UN, IAEA and OPEC provides opportunity for it to play a active role in their energy agenda. It is necessary to foster this multilateral co-operation for rapid national economic development. From past experiences in the effort of the Africa region towards economic integration, it is clear that a step-by step approach based on common interests and the pooling of resources offers the best prospects for a successful and lasting integration. In this respect, the energy sector offers some mutually beneficial opportunities for projects, which can be implemented in the short to medium term.

4.4.1 Policies

- i. Nigeria's energy resources shall be deployed in promoting and enhancing regional and international co-operation for the overall economic and technological advancement of the nation.
- ii. Nigeria shall lay emphasis on fostering and strengthening energy cooperation and integration within the ECOWAS sub-region.

4.4.2 Objectives

- i. To enhance Nigeria's effective participation in international energy related organisations.
- ii. To facilitate the acquisition of technology for the development of the energy sector.
- iii. To encourage a cooperative approach in the exploitation of energy resources and development of energy supply infrastructure.
- iv. To optimize the utilisation of the region's energy resources.

4.4.3 Strategies

- i. Working out a co-ordinate approach to regional and sub-regional energy planning based on co-operation and consultation among member countries of ECOWAS and other member of the Organisation of African Unity.
- ii. Facilitating the establishment of mechanisms within the ECOWAS sub region and other African countries to enhance energy trade and interchange of relevant technology and information.
- iii. Promoting favourable trading relationships with member countries of ECOWAS and the OAU, which will ease the financing of energy supply and other energy-related projects.
- iv. Working out viable cooperative arrangements to allow for the easy distribution of petroleum and gas within the region.
- v. Mobilising domestic capital within the community and creating a favourable investment climate to attract international financing for energy development projects.
- vi. Ensuring Nigeria's active membership in energy related regional and international organisations.
- vii. Pooling available human resources through networking of national energy training and research centres.
- viii. Encouraging the standardization of energy related plants, machineries and spares and the establishment of infrastructural facilities within the community for their production.

Chapter Five

ENERGY FINANCING

5.1 Financing

Funding requirements for the entire energy sector is substantial. New investments are needed for exploration and exploitation activities. The required type of financing is long-term and involves both foreign and domestic financing resources. However, foreign earnings provide the greater proportion of needed of needed funds.

Considering the risk element involved in energy project, investments in the sub-sector should be capable of yielding high rates of return and fast pay back periods in order to attract investors. Owing to other competing needs, government alone cannot continue to provide the major finance for the energy sector activities. Hence private sector participation is necessary and imperative. To attract foreign investments in the energy sector, certain necessary conditions would have to be met. These include:

- (1) Improvement in the financial performance of the energy supply companies in the country.
- (2) A conducive environment for investment that also protects our national interests.

5.1.1 Policies

- i. The nation shall explore and adopt all viable financing options from local and international sources for cost effective exploitation of its energy resources.
- ii. Investments in the energy sector shall be accorded high priority within the economic sector.
- iii. Government shall encourage private investment, both domestic and foreign in the energy sector.

5.1.2 Objectives

- i. To ensure the availability of adequate funding for the energy sector.
- ii. To ensure continuity in the funding of projects in the energy sector.

- iii. To ensure that the energy supply options adopted are the most cost effective for the country.
- iv. To increase foreign exchange earnings through export of energy products.
- v. To encourage the local development of energy technology with a view to minimising the cost input of energy projects.

5.1.3 Strategies

- i. Establishing an energy development fund for training, research, development and demonstration, and technology acquisition.
- ii. Providing fiscal incentives for prospective investors in the energy sector.
- iii. Increasing private sector participation in the energy industry.
- iv. Ensuring a reasonable return on investments through cost-effective energy pricing.
- v. Establishing guaranteed and dependable repayment schemes for loans invested in energy projects.
- vi. Establishing a favourable investment climate to attract investments in the energy sector.
- vii. Providing adequate infrastructural facilities to enterprises involved in the development of the energy sector.
- viii. Encouraging the establishment of offshore banking units to attract inflow of offshore investment funds, as well as activities of international investment banking and brokerage firms.
- ix. Furthering the internationalization of Nigeria's Capital Market by encouraging the stock of Nigeria's corporate units to be quoted in the international Stock Exchanges to attract inflow of foreign portfolio investment capital.
- x. Expanding the scope of venture capital financing to embrace investments in the energy sector.

PLANNING AND IMPLEMENTATION

6.1 Energy Planning

Energy issues are multidimensional in nature and there are strong interactions between factors that affect energy demand, supply and consumption which must be recognised in order to have an effective energy plan.

To ensure full consideration of all the factors, and avoid inconsistencies in energy plans, it is imperative that a comprehensive and integrated approach to energy planning be evolved. The planning must consider the interactions between the sub-sectors of the energy sector itself, and the plans within each sub-sector.

6.1.1 Policies

- i. An integrated energy planning system shall be developed involving the energy related programmes and activities of the various sectors of the economy.
- ii. The energy planning system shall be comprehensive, covering the resources exploitation, Processing, and consumption activities
- iii. The energy plans and programmes shall be consistent with the overall national development goals.

6.1.2 Objectives

- i. To ensure coherence in the energy plans and activities of the various sectors of the economy due to their inter-relatedness
- ii. To provide a framework for national decision making in energy related matters.
- iii. To ensure adequate supply of energy to different sectors of the economy.
- iv. To optimize the supply and utilization of the various energy resource types.
- v. To provide a system for the development of indigenous capabilities in energy conversion technologies.

- vi. To provide vital input into national development of the energy sector.

6.1.3 Strategies

- i. Strengthening co-operation between the Energy Commission of Nigeria and the other bodies active in the energy sector.
- ii. Encouraging formal discussion and collaboration between institutions in the energy sector whose activities are inter-related.
- iii. Establishing energy planning and implementation units at state government levels and assigning responsibilities for energy related matters at local government levels.
- iv. Establishing a national energy information system which will involve consistent data gathering and processing of energy resource inventory, consumption pattern, energy technologies, and other relevant socio economic parameters.
- v. Developing an energy master plan which is based on the study of energy demand by energy type and category of end-use, energy supply, as well as energy-economy- environment interactions.
- vi. Instituting an accelerated and effective manpower development programme.

6.2 Policy Implementation

No policy can succeed without proper implementation. To achieve the stated policy objectives and successfully implement the strategies, various instruments including economic measures, information and education, legislative measures and institutional arrangements need to be used.

Policy programme realisation is often hampered by bureaucratic bottle-necks and delays. These problems shall be effectively addressed for the successful implementation of this Energy Policy.

6.2.1 Policy

The Energy Commission shall be the focal point for the coordination of the implementation of the nation's energy policy.

6.2.2 Objectives

- i. To ensure the effective implementation of the energy policy

- ii. To ensure that the energy sector plays its expected role in the realization of the goals of the national development plan.

6.2.3. Strategies

- i. Ensuring the existence of a forum to provide opportunities for regular discussions among agencies and departments involved in the production or utilization of energy.
- ii. Encouraging private sector participation in the provision of energy services in the country, while recognizing the role of government in the provision of some basic energy infrastructure.
- iii. Instituting a system of carrying out regular checks and receiving reports on the implementation of the approved policy by all sections of the energy sector.
- iv. Ensuring that approved fiscal measures which are necessary for the achievement of set objectives of the policy are promptly carried out.
- v. Dedicating a certain percentage of the nation's income from conventional energy sub-sector to support research and development, and training activities in the energy sector.
- vi. Creating regular fora for public awareness, education and participation in the realization of the goals and objectives of the energy policy.
- vii. Enacting a set of necessary legislations to enforce targets about energy efficiency, energy information gathering, and fuel mix of the national energy consumption, amongst others.
- viii. Integrating energy studies into the curricula of secondary and tertiary institutions, while emphasizing their multi-disciplinary nature.

6.3 Implementation Strategy

The implementation process of the Energy Policy, as presented, requires strategies that allow for a number of factors including priority setting, policy continuity and a clear focus on key issues.

Accordingly, such strategies should be based on realistic targets, a defined time frame as well as effective target evaluation.

The advantages of this approach are two-fold.

- (i) It will enable planners and implementing organs to include the cost of each strategy in their respective budgets, as they fall due; and

(ii) It will aid monitoring organs to assess the progress of implementation of the various strategies. In this regard and, in line with usual planning horizon, it is expected that short term measures are those that could be evaluated within 1 to 2 years. A 5-year period is advocated for medium-term activities. With this perspective, the recommended activities are as indicated below.

6.3.1 Short Term Measures

General

- (1) Establishment of necessary guidelines and regulations on energy efficiency,
- (2) Development and implementation of the necessary machinery for constant monitoring of the implementation of the approved energy policy and compliance with the guidelines and regulation on various energy matters by all sectors of the economy.
- (3) Ensuring the implementation of fiscal measures necessary for the achievement of the set objectives of the energy policy.
- (4) Rehabilitation of refineries, petroleum products distribution infrastructure, power plants, transmission and distribution network.
- (5) Continuation of the promotion of the establishment of local services companies for the oil, gas, electricity, etc sub- sectors and encouraging their patronage by the energy companies.
- (6) Increased patronage of indigenous engineering and applied research groups in the execution of projects right from feasibility studies.
- (7) Development and implementation of appropriate packages to enhance the utilization of renewable energy to solve rural energy problems and to make possible the extension of commercial energy and the associated technology to the rural sector.
- (8) Energy audit in the agricultural and industrial sectors to identify and quantify the structure of energy supply, demand, utilization patterns, efficiencies and substitution potentials etc., for both the small scale and large scale farming the industrial enterprises.
- (9) Strengthening of all relevant regulatory agencies in order to ensure the enforcement of appropriate set of standards and procedures, including in particular standards and procedures on exploration, production and utilization of energy.

- (10) Establishment of a programme for the liberalization and privatization of the energy sector.
- (11) Development and implementation of appropriate and dynamic pricing and tariff structures for petroleum products, gas, electricity and other energy types, which will encourage private sector participation, by ensuring a reasonable return on investments while giving due attention to the needs of the target markets.
- (12) Improvement of the effectiveness of energy planning and implementation by establishing energy planning and implementation units at state government levels and assigning responsibilities for energy related matters at local government levels.
- (13) Establishment of a national energy information system which will involve consistent data gathering and processing of energy resources inventory, consumption pattern, energy technologies, and other relevant socio-economic parameters.
- (14) Intensification of action on the development of an energy master plan.
- (15) Encouragement of interaction within existing for a for formal discussions and collaboration between institutions in the energy sector.
- (16) Encouragement of private sector participation in the energy sector through liberalisation and privatization of the sector, as well as fiscal and other appropriate measures.
- (17) Establishment of a strategy for the public awareness, education and participation in the realization of the goals and objectives of the energy policy.
- (18) Monitoring and assessment of technological developments in all energy areas and development of capabilities to apply them, as appropriate in the various sectors of the economy.
- (19) Establishment of a plan which will encourage increased placement of Nigerians in all positions in the energy producing, service and processing companies, including especially in key decision - making and technical positions in oil, gas, nuclear and other relevant energy industries.
- (20) Strong encouragement of the energy producing and processing companies to set up R & D outfits in the country and to make use of R & D institutions in Nigeria.

- (21) Increased furnishing to appropriate agencies for the provision of energy related manufacturing infrastructure.

Oil

- (22) Easing of the constraints on the importation of essential but scarce materials for the manufacture of engineering equipment's and spaces on
- (23) Updating of the memorandum of understanding to ensure that it contains appropriate incentives that will attract investment in intensified crude oil exploration and development.
- (24) Maximisation of petroleum production and processing efficiencies.
- (25) Improvement and promotion of the provisions put in place for the establishment of export refineries.

Natural Gas

- (26) Review of and improvement of existing incentives to producing companies to encourage them to gather and utilize associated gas.
- (27) Review of existing penalties for gas flaring and ensuring that they achieve the desired effect.
- (28) Establishment of appropriate arrangements to ensure the implementation of the incentives and penalties to discourage gas flaring.
- (29) Setting of a target date for the termination of gas flaring.
- (30) Establishment of appropriate guidelines, regulations and incentives for the participation of indigenous and foreign entrepreneurs in the establishment of the infrastructure for, and business in gas gathering, transmission and distribution.
- (31) Provision of funding for the establishment of an infrastructure for gas gathering, transmission and distribution.
- (32) Review and sustenance of the implementation of incentives to industrial and domestic consumers to use gas or change over to gas.
- (33) Sustenance and expansion of the measures presently in place for the establishment of infrastructure and markets for the export of natural gas.
- (34) Formulation of suitable urban and regional planning regulations needed for the effective distribution of natural gas to domestic and industrial consumers.

Tar Sands

- (35) Undertaking of more detailed geological studies for the tar sands deposits of the country.

Coal

- (36) Development and implementation of appropriate measures for large scale production of coal stoves at affordable prices and for the establishment of coal-based industries, by local entrepreneurs.
- (37) Provision of adequate funding to enable intensified coal exploration activities.

Nuclear

- (38) Intensification of Research, Development and Training in Nuclear Science and Technology for peaceful applications.
- (39) Evolution of a rational nuclear development programme and institutional arrangements.
- (40) Implementation of the institutional arrangement and regulation for Nuclear Radiation Protection.
- (41) Acquisition and operation of pilot-scale gamma irradiation facilities for food industrial applications.
- (42) Regular public enlightenment campaigns on peaceful applications of nuclear technology.
- (43) Intensification of exploration activities for materials for nuclear fuels.
- (44) Fostering of co-operation with the IAEA through encouragement of the national counterpart agency to actively participate in all IAEA programme.

Hydropower

- (45) Constant review and improvement of multilateral agreements for monitoring and regulating the use of water in international rivers flowing through the country.
- (46) Increased patronage of indigenous entrepreneurs involved in the planning, design and construction of hydropower plants.
- (47) Establishment of appropriate fiscal measures as incentives to indigenous and foreign entrepreneurs for the local production of hydropower plants and accessories.
- (48) Establishment of appropriate institutional arrangements, regulations, and guidelines for the development of small scale hydropower plants.

Fuelwood

- (49) Cultivation of fast growing tree species needed to accelerate the regeneration of forests.

- (50) Development of smokeless coal, sawdust, biogas and other energy technologies as alternatives to fuelwood.
- (51) Improvement of the efficiencies and performances of existing improved woodstoves and ovens.
- (52) Encouragement of the establishment of private and community woodlots for the supply of fuelwood.
- (53) Ensuring the availability and effective distribution of kerosene as an alternative to fuelwood in the interim.
- (54) Promotional activities, such as extension and pilot projects, to disseminate solar, biogas and other alternative technologies to fuelwood.

Environment

- (55) Organisation of systematic public enlightenment campaigns on the problems of desertification and soil erosion arising from deforestation.
- (56) Review and enforcement of forestry laws to effectively stop the willful felling of trees in prohibited zones.
- (57) Dissemination of information on existing energy efficient and environmentally friendly technologies in the exploitation of various energy resources.
- (58) Development and implementation of guidelines and regulations on appropriate technologies for the exploitation of energy resources to minimize harmful environmental effects.
- (59) Intensification of research development in more efficient and environmentally friendly utilisation of various energy sources.
- (60) Encouragement of the utilisation of environmentally friendly energy resources and technologies.

Solar, Biomass and Wind

- (61) Demonstration and pilot projects as well as workshops and public education campaigns on solar energy, biomass, biogas, wind and other renewable energy resources to ensure their adoption and market penetration.
- (62) Establishment of appropriate fiscal measures as incentives for the utilisation of solar, wind and other renewable energy systems.
- (63) Establishment of a set of regulations and guidelines to promote and sustain the local solar, biomass and other renewable energy industry.
- (64) Development and implementation of training packages for skilled

craftsmen and technicians on the production, operation and maintenance of solar, wind, biomass and other renewable energy systems.

Other Renewable Energy Resources

- (65) Gathering information on the advances in less developed renewable energy resources. Extension of the energy information acquisition, storage and dissemination activities to them.

Electricity

- (66) Completion of on-going short term projects designed to satisfy national demand for electricity.
- (67) Expansion of the existing electricity transmission and distribution networks.
- (68) Intensification of research, development and training in alternative sources of energy for the generation of electricity.
- (69) Establishment of a programme for the liberalisation and privatisation of the electricity subsector.
- (70) Development of appropriate infrastructure, guidelines and regulations for the management of a liberalised and privatised electricity subsector.
- (71) Commercialization of electric utility agencies and granting them managerial and financial autonomy to enable them operate efficiently.
- (72) Review and strengthening of existing incentives for them encouragement of local manufacture of electrical equipment and devices.
- (73) Establishment of effective measures to ensure the security of electrical installations and improving the operational efficiency of the electricity sub-sector, particularly the distribution activities.

Industry

- (74) Development and implementation of appropriate measures to encourage fuel substitution in industries.

Agriculture

- (75) Intensive promotion of the utilization of renewable energy in agriculture through demonstration, pilot projects, workshops, etc.
- (76) Intensification of research and development activities for appropriate agricultural technologies that can use available and multiple energy resources, including animal traction.

Transport

- (77) Periodic review of transport fuels storage capacity, in accordance with developments in the transport sector, with a view to updating the storage capacity guidelines and storage infrastructure.
- (78) Comprehensive study of the transport fuel distribution systems and development of recommendations for their improvement.
- (79) Initiation of discussions with relevant institutions in the transport sector to identify appropriate energy efficient transport systems, strategies and equipment that should be introduced.
- (80) Encouragement of the relevant agencies to introduce fuel efficient transport management systems
- (81) Encouragement of the relevant agencies to improve and expand mass transportation and communication systems country-wide.

Energy Conservation

- (82) Development of codes, standards, regulations and guidelines on energy conservation and use of energy efficient methods, equipment, machineries and technologies in agriculture, industry, building design and construction, etc.
- (83) Establishment of appropriate institutional arrangements for the promotion and monitoring of energy conservation and use of energy efficient methods

Research, Development and Training

- (84) Provision of increased funding to research institutes, centres and tertiary institutions who are undertaking R & D work on renewable, nuclear, coal and other energy resources to ensure productive R & D and the establishment of appropriate infrastructure.
- (85) Development and implementation of a programme of R & D in energy conservation and efficiency.
- (86) Promotion of the development and introduction of integrated energy and environment curricula and disciplines into the programmes of tertiary institutions.
- (87) Taking measures to ensure adequate institutional capacity for the production of adequate numbers and quality of high level and skilled technical and managerial manpower for the energy sector.
- (88) Establishment of the necessary machinery to provide adequate funding

from conventional energy sub-sectors to support research, development, demonstration and training in energy.

- (89) Development and initiation of the implementation of an accelerated and effective manpower development programme for the energy sector.

Finance

- (90) Provision of appropriate measures to encourage prospective investors in the energy sector.
- (91) Expansion of the scope of Venture Capital Financing (National Risk Fund Plc) to embrace investments in the energy sector.
- (92) Establishment of quaranted and dependable repayment scheme for loans invested in energy projects.

6.3.2 Medium Term Measures

General

- (1) Continuation of short-term activities
- (2) Development of other potential sites for hydropower, gas and coal plants for electricity generation.
- (3) Monitoring and ensuring the progress of the plan for achieving the placement of Nigerians in key decision making positions and other responsibilities in the energy industries.
- (4) Establishment and sustenance of the implementation of a national energy master plan.
- (5) Increasing the priority given to the provision of facilities for the production of ferro-alloys and flats for the manufacturing industries.

Oil

- (6) Ensuring the attainment of a reserve target of 25 billion barrels and a production capacity of 2.5 mbpd.
- (7) Commercialisation of the operations of existing refineries while taking steps to promote private sector participation in the refining business.
- (8) Expansion of transmission and storage facilities for petroleum products to achieve the 45-day strategic reserves.

Natural Gas

- (9) Review of progress as well as incentives and penalties established towards the termination of gas flaring and revision of the target date if necessary.

- (10) Sustaining funding for the expansion of the infrastructure for gas gathering, transmission and distribution.
- (11) Intensification of promotional activities for the use of gas and change over to gas by industrial and domestic consumers.
- (12) Implementation of urban and regional planning regulations for effective distribution of natural gas.

Tar Sands

- (13) Continuation of detailed exploration activities and mapping of the Tar Sands deposits in the country.
- (14) Establishment of appropriate institutions, guidelines, facilities and regulation for the development and harnessing of Tar Sand.

Coal

- (15) Review, improvement and effective implementation of measures for the production of coal stoves and the establishment of coal-based industries.
- (16) Establishment of smokeless coal pilot projects for the promotion of the use of smokeless coal as an alternative to fuelwood.

Nuclear

- (17) Acquisition of nuclear research facilities and expansion of their applications in manpower training, agriculture, medicine and industry.
- (18) Commencement of the exploitation of the nuclear mineral resource deposits in Nigeria.

Hydropower

- (19) Introduction of alternative technological options to reduce the impact of water shortage on hydropower plants.
- (20) Establishment of basic engineering infrastructure for the production of hydropower plants equipment and accessories.

Fuelwood

- (21) Ensuring the availability and effective distribution of kerosene and other viable alternatives to fuelwood.
- (22) Conferment of reserve status on greater acreage of forest and establishment of an effective system of forest regeneration.
- (23) Development of appropriate pricing structure to encourage substitution from fuelwood to alternative fuel types.

Solar, Biomass and Wind

- (24) Continuation of the establishment and monitoring of renewable energy pilot projects and other overflow short term activities.

- (25) Establishment of pilot projects to assist local entrepreneurs in the manufacture of biomass energy conversion devices.
- (26) Setting up pilot workshops for the manufacture of renewable energy equipment and devices such as solar cells, PV panels and systems, wind energy equipment and biogas generators, etc.

Other Renewables

- (27) Continuation of data gathering, Storage and dissemination activities while encouraging R & D activities in the less developed renewable with a view to possible exploitation.

Electricity

- (28) Implementation of the programme for the liberalisation and privatisation of the electricity sub-sector.

Agriculture

- (29) Ensuring wider adoption of animal traction and simple agricultural technologies that can use multiple energy resources.
- (30) Training of existing extension personnel in the effective dissemination of the newly developed energy technologies for agriculture.

Transport

- (31) Rehabilitation and expansion of the road rail and river transport network as well as port facilities for the handling of coal.
- (32) Development and implementation of appropriate strategies to attract investments in natural gas pipeline networks and to promote conversion to natural gas for road, river and rail transportation.
- (33) Encouragement of the building of natural gas filling stations as part of road, river and rail networks.
- (34) Implementation of the approved recommendations of the study of the transport fuel distribution system.
- (35) Implementation of the approved recommendations from the investigations on the appropriate energy efficient transport systems, strategies and equipment.

Energy Conservation

- (36) Implementation of the codes, standards, regulations and guidelines on energy conservation and use of energy efficient methods, equipment, machineries and technologies in agriculture, industry, building design and construction, etc.

- (37) Establishment of expand use of energy efficient mass transportation and communication system.

Research, Development and Training

- (38) Establishment of a National Electricity Research, Development and Training Institute to undertake R, D & T activities in generation, transmission and distribution of electricity, and Zonal Training Centres for the training of various cadres of professional and skilled manpower for the electricity sub-sector.
- (39) Development, through adequate funding, or the capabilities of the petroleum training institutions to include R & D activities on oil and gas related issues and on tar sands for the production of lubricants and other heavy oil products.
- (40) Adequate provision of equipment for the energy related research, development and training institutes, and centres to enable them provide the necessary facilities and services needed by enterprises involved in the development of the energy sector.

Finance

- (41) Establishment of a special risk fund scheme for the commercialisation of new and emerging energy technologies, such as renewable energy technologies.
- (42) Encouraging the attraction of long-term financing from international finance institutions comprising international capital markets and brokerage firms and allowing international brokerages firms to establish and operate in Nigeria.
- (43) Encouraging the establishment of off-shore banking units to attract regular inflow of off-shore funds.

6.3.3 Long Term Measures

General

- i. Review, improvement and sustenance of medium-term measures
- ii. Effective Nigerianization of the personnel in the energy industries.
- iii. Review, strengthening and sustaining of the implementation of the national energy master plan.
- iv. Full integration of renewable, nuclear and conventional energy resources into an optimal energy mix.

Oil

- v. Maintenance of a minimum crude oil and condensate reserve of 25 billion barrels,
- vi. Complete privatization of the petroleum processing industries.
- vii. Further expansion of the transmission and storage facilities for petroleum products to achieve at least a 90-day strategic reserves.

Natural Gas

- (viii) Termination of gas flaring
- (ix) Putting in place an effective infrastructure for gas gathering transmission and distribution, and for the export of natural gas.
- (x) Exploration for natural gas.

Tar Sands

- (xi) Continuation of exploration activities to identify and quantify areas with tar sand deposits in Nigeria.
- (xii) Establishment of a tar sands production and processing industry in the country.
- (xiii) Development and implementation of strategy for discouraging the importation of heavy crude oil.

Nuclear

- (xiv) Encouragement of the wide-spread construction of mini-and micro - hydropower plants.

Hydropower

- (xv) Encouragement of the wide-spread construction of mini- and - micro hydropower plants.

Solar, Biomass and Wind

- (xvi) Encouragement of the wide spread production and installation of renewable energy system.

Electricity

- (xvii) Establishment of the infrastructure for the local manufacture of electrical equipment, devices and materials.

Finance

- (xviii) Internationalization of Nigeria's capital market to enable Nigerian cooperate units' stocks listed in the international stock exchanges to attract inflow of foreign investment capital.

APPENDIX

APPA	-	African Petroleum Producers Association
ECOWAS	-	Economic Community of West African States
GDP	-	Gross Domestic Product
Gwh	-	Gigawatt-hours
IAEA	-	International Atomic Energy Agency
Kw	-	Kilowatts
Kg	-	Kilograms
Km ²	-	Square Kilometers
MW	-	Megawatts
Mbpd	-	Million barrels per day
NEPA	-	National Electric Power Authority
NNPC	-	Nigerian National Petroleum Corporation
OPEC	-	Organization of Petroleum Exporting Countries
PV	-	Photovoltaic
R&D	-	Research and Development
R,D&D	-	Research, Development and Demonstration
R,D&T	-	Research, Development and Training
UN	-	United Nations