

**FEDERAL REPUBLIC OF NIGERIA**

**NATIONAL ENERGY POLICY**

**THE PRESIDENCY**

**ENERGY COMMISSION OF NIGERIA**

**APRIL 2003**

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## FOREWORD

The nature and extent of energy demand and utilization in a national economy are, to a large extent, indicative of its level of economic development. For a productive economy and for rapid and secure economic advancement, the country must pay maximum attention to the optimal development and Utilization of her energy resources and to the security of supply of her energy needs.

To do this, the country needs to put in place a co-ordinated and coherent energy policy, which will serve as a blueprint for the sustainable development, supply and utilization of energy resources within the economy, and for the use of such resources in international trade and co-operation. The policy must also address the issues of energy manpower development, indigenous participation, domestic self-reliance, the energy needs of various sectors of the economy, energy sector financing, as well as private sector participation in the energy sector. Luckily, the country is endowed with many energy resource types, including oil, gas, coal, tar sands, solar, hydro, biofuels and other renewable energy resources. The national policy should therefore promote the harnessing of all the viable energy resources so as to have an optimal energy mix, while ensuring sustainable and environmentally friendly energy practices.

Hitherto, existing policies in the energy sector have been those of individual energy sub-sectors such as electricity, oil and gas, and solid minerals. These had been developed from the limited perspectives of each of the sub-sectors and had resulted, in some cases, to conflicting policies and programmes, to the detriment of the country as a whole. There is need, therefore, for a comprehensive and integrated national energy policy so as to provide proper direction to the development of the entire energy sector. Furthermore, such a document will assist the international investing community in appreciating the thrust of government on energy matters.

A Draft National Energy Policy had earlier been developed by the Energy Commission of Nigeria in 1993. This was reviewed by an Inter-ministerial Committee in 1996, at the instance of the head of State, under the Chairmanship of the Ministry of Science and Technology. In view of recent and major developments in the national economy, especially the restructuring of the energy sector towards greater private sector participation and, indeed, private sector leadership, the President and

Commander in Chief of the armed Forces, and Chairman of the Energy Commission, set up an Inter-ministerial Committee, Under the Secretary to the Government of the Federation, to review the 1996 Document. The Inter-ministerial Committee membership includes the major Energy sector, professional and financial institutions which are considered very Relevant to the evolution and eventual implementation of the National Energy Policy.

The resulting policy document covers the development, exploitation and Supply of all the nation's energy resources. It also covers key energy utilization sectors; energy related issues such as environment, energy efficiency and energy financing and energy policy implementation. It includes strategies for systematic exploitation of the energy resources, the development and effective use of energy manpower, supply of rural energy needs, efficient energy technology development and use, energy security, energy financing and private sector participation. The strategies are finally harmonized and grouped into short-medium – and long – term measures for easier implementation.

It is hoped that this document will provide the framework for a better development of the energy sector and for a more effective contribution of the sector to the national economy.

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## **CHAPTER ONE**

### **INTRODUCTION**

Energy has a major impact on every aspect of our socio-economic life. It plays a vital role in the economic, social and political development of our nation. Inadequate supply of energy restricts socio-economic activities, limits 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. These will require increased energy consumption. Thus, 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.

#### **Need for a National Energy Policy**

The level of energy utilization in an economy, coupled with the efficiency of conversion of energy resources to useful energy, are directly indicative of the level of development of the economy. In order to ensure optimal, adequate, reliable and secure supply of energy to, and its efficient utilization in the country, it is essential to put in place a co-ordinated, coherent and comprehensive energy policy. The policy will serve as a blue print for the sustainable development, supply and utilization of energy resources within the economy, and for the use of such resources in international trade and co-operation.

Hitherto, existing policies in the energy sector have been those of the separate energy sub-sectors, namely, electricity, oil and gas and solid minerals. There had also been energy related policies developed in sub-sectors whose activities are strongly dependent on those in the energy sector. These include transportation, agriculture, science and technology and environment, among others. The sub-sectoral policies, however, reflect the individual sub-sectoral perspectives. It is necessary to have an integrated energy policy, which will guide future energy related sub-sectoral policy developments, in order to avoid policy conflicts which may, otherwise, arise. An overall national energy policy is also normally needed and requested by foreign investors who wish to invest in the nation's economy.

In 1984, the Federal Ministry of Science and Technology produced a Draft Energy Policy Guideline. The contents were however limited in scope and depth. The Energy Commission of Nigeria, in furtherance of its mandate, produced a Draft National Energy Policy in 1993. This was later reviewed in 1996 by an Inter-ministerial Committee, under the Chairmanship of the Ministry of Science and Technology. The document was yet to be approved by the Federal Executive Council. In view of significant changes in the orientation of the economy, especially as regards increased private sector participation, it had become necessary to review the 1996 document, prior to its approval. The result of that review by an Inter-ministerial Committee, appointed by Mr. President, is presented in subsequent sections.

### **Socio-Economic Background**

The nation's overall economy, as measured by the Gross Domestic Product (GDP), has grown by about 3.4% annually between 1990 and 2000. In recent years, the GDP has actually increased from ₦116.1 billion in 1999 to ₦125.4 billion in the year 2001, at 1984 factor cost. On a per capita basis, it has fluctuated between ₦1041.5 and

₦1075.9, with an average of ₦1059.3, between 1990 and the year 2001. Over the last five years, the per capita GDP has, however, generally grown at an annual average rate of 0.34%. The population was estimated to be 88.99 million (1991 Census), with a growth rate of about 2.83% and a rural population of over 60% of the total.

The structure 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 remained between 37.8% and 41.5% between 1990 and 2001. Correspondingly, agricultural exports, which had been the main source of foreign exchange earnings, have declined and, the dollar value of food and live animals imports has increased by about 13% per annum between 1990 and 2000. On the other hand industry's contribution to GDP has increased slightly from about 13% in 1960 to about 16.9% in the year 2001. A closer examination of this increase, however, reveals that the rise was not due to any major leap in industrial development, since the contribution of the manufacturing sector in industry stood at about 35.2% only, in 2001. What industry has gained is primarily due to increase in oil production, whose contribution in industry stood at about 62.7% in the same year.

### **Energy and the Economy**

Nigeria is blessed with abundant primary energy resources. These include reserves of crude oil and natural gas, coal, tar sands and renewable energy resources such as hydro, fuelwood, solar, wind and biomass. However, since the late 1960s, the economy has been solely dependent on the exploitation of oil to meet its development expenditures. In 2001, oil revenue alone accounted for about 98.7% of exports and 76.5% of total government revenues. However, its contribution to GDP was only 10.6%. This shows the low level of value added, by the oil sector, to the economy.

## *Introduction*

The total commercial energy consumption in 2001 was 45.55 million tce. The dominant source of commercial energy had been oil, accounting for over 66% of commercial energy consumption between early 1970s and 1988. Its contribution, however, dropped from 46.7% to 31.9% between 1990 and 2001. Natural gas production, which is mostly in association with oil production, is appreciable. Its contribution to commercial energy consumption, on the other hand, had increased from 29.8% in 1990 to 61.9% in 2001. However, not less than 50% of the natural gas produced was being flared by the end of 2001. 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 2001, coal's share of the total commercial energy consumption was about 0.02%.

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 resource for electricity generation in the country, contributing about 32% of the total installed grid-connected 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 adequately captured in the national accounts. Nevertheless, solar energy has great potential for the provision of power for rural development.

### **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 supply/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 exist adequate and diversified energy supply options in the country, the problem of unreliability of supply constitutes a huge drain on the national economy. This leads to energy insecurity and had constituted a major characteristic of the energy crisis experienced by the country over the last decade, especially with regards to the supply of electricity and petroleum products. Therefore, attention must be given to adequate production levels and a reliable distribution network for all fuel types to ensure steady economic growth.

### **Private Sector Participation**

With the exception of the upstream oil and gas sub-sectors, and to a smaller extent the electricity sub-sector, government has been largely responsible for the ownership and operation of the energy sector industries. In particular, investment capital had been sourced from public funds, while the industries had relied on the sense of public interest, within management, as the motivation for responsible and transparent management of the industries.

The funds required for the maintenance and refurbishment of the energy supply infrastructure, and for the expansion of capacity, are enormous. In the face of increasing demands on government for investments in other areas of the economy such as transport, health, education and security, government has been unable to provide the funds needed by the energy sector. Efficient and transparent management of the industries had also not been achieved. Consequently, established facilities had progressively deteriorated while new capacity had not been added, inspite of increasing demand. Furthermore, the funding and management deficiencies had given rise to inadequate and unreliable supply, especially of electricity and petroleum products, insecurity of the energy supply system and loss of productivity the economy.

It is believed that increased private sector participation in the energy sector will attract new investments to the sector, while the profit motive will assist in solving much of the management problems experienced under public ownership. The restructuring of the sector, required to bring this about, will involve both deregulation and privatization.

The greater proportion of private investment funds required by the sector will be foreign capital. Thus, the environment must be made conducive to attract foreign

investments to the sector. This notwithstanding, it is necessary to encourage and promote indigenous private sector participation in the sector.

### **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 (ECN) 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, NNPC, Nigeria Coal Corporation etc. It is important to realize 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 energy sector companies 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 programmes.

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.

### **Policy Overview**

The national energy policy recognizes the multi-dimensional nature of energy and therefore addresses diverse issues such as research and development, energy pricing and financing, legislation, energy efficiency, environment etc. The overall thrust of the energy policy is the optimal utilization of the nation's energy resources for sustainable development.

### **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 resources option, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix.

- ii. To guarantee increased contribution of energy productive activities to national income.
- iii. To guarantee adequate, reliable and sustainable 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 substantial private sector participation.
- vii. To ensure a comprehensive, integrated and well informed energy sector plans and programmes for effective development.
- viii. To foster international co-operation in energy trade and projects development in both the African region and the world at large.
- ix. To successfully use the nation's abundant energy resources to promote international co-operation.

## CHAPTER TWO

### ENERGY SOURCES

#### **Oil**

Crude oil was discovered in commercial quantities in Nigeria in 1956 while oil production started in 1958. The nation had a proven reserve estimate of about 32 billion barrels of predominantly low sulphur light crude, as at January 2002. The annual oil production peaked at about 845 million barrels in 1979. There was a decline in production to 451 million barrels in 1983 after a major market collapse that began in 1981 and lasted till 1987. Thereafter, it rose again to 776 million barrels in 1998.

Nigeria has four refineries with a total installed capacity of 445,000 barrels per day. However, capacity utilization is low. Consequently, 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 requirements.

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.

***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.
- iv. The nation shall encourage the adoption of environmentally friendly oil exploration and exploitation methods.
- v. The nation shall progressively deregulate and privatize the oil industry.

***Objectives***

- i. To increase the reserve to production ratio.
- ii. To ensure that refining to consumption ratio is greater than unity, so as to ensure domestic self-reliance in the production of petroleum products for domestic consumption.
- iii. To adequately protect the country from the vulnerability of oil price fluctuations.
- iv. To ensure adequate and reliable supply and distribution of petroleum products to meet the demand of the domestic market.
- v. To derive more economic benefits from the nation's crude oil resources.
- vi. To accelerate the process of technology acquisition and diffusion in the oil industry.
- vii. To enhance indigenous capability in such a vital industry to national security.
- viii. To improve the efficiency in the management and operation of the oil industry.

- ix. To attract increased private sector capital inflow to the oil industry.

***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. Expanding and promoting research and development activities 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 investments and ensure reasonable returns.
- vi. Ensuring adequate geographical coverage of oil refining and petroleum products distribution network.
- vii. Ensuring the availability of adequate strategic reserves of storage capacity for refined products for at least 90 days of forward consumption.
- viii. Encouraging local engineering design and fabrication of equipment and spares in Nigeria.
- ix. Ensuring the use of locally available materials, such as bentonite and barytes, for oil exploration.
- x. Emphasizing the processing of crude oil for export to withstand the adverse effect of crude oil price fluctuations.
- xi. Reviewing existing laws and regulations to create the enabling environment for increased private sector participation in the oil industry, especially in the downstream sub-sector.
- xii. Improving the living standards of people in oil producing communities through the provision of socio-economic infrastructure.

## **Natural Gas**

Nigeria's proven natural gas reserves, estimated at about 163 trillion standard cubic feet, are known to be substantially larger than its oil resources in energy terms. Gas discoveries in Nigeria are incidental to oil exploration and production activities. As at 2001, over 50% of the gas produced (mainly associated gas) was 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 44 years, based on about 2mb/d production, while that for natural gas is about 88 years, based on the 2001 production rate of 1850 bscf. 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, so that the ending of gas flaring does not exceed the deadline of 2008.

### ***Policies***

- i. The nation's gas resources shall be harnessed and optimally integrated into the national economy, energy mix and industrial processes.

## *Energy Sources*

- 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.
- iv. The nation shall put in place necessary infrastructure and incentives to ensure adequate geographical coverage of the gas transmission and distribution network.

## *Objectives*

- i. To eliminate the flaring of associated gas by 2008.
- ii. To expand the utilization of natural gas as industrial and domestic fuel, as well as for power generation.
- iii. To increase the use of natural gas as industrial feedstock for petrochemical, pharmaceutical and fertilizer plants, etc.
- iv. To use gas to diversify the foreign exchange earning base of the nation.
- v. To accelerate the process of technology acquisition and diffusion in the gas industry.
- vi. To encourage indigenous entrepreneurial capability in the gas industry including the development of end-use devices.
- vii. To determine the level of gas reserves available to the nation.

## *Strategies*

- i. Encouraging the oil-producing companies to gather and utilize associated gas in order to eliminate flaring by 2008.
- 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 nationwide.

- iv. Providing incentives to encourage industrial and domestic consumers to use gas or to convert to gas.
- v. Providing incentives to encourage the introduction and use 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. Expanding and promoting 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, and its utilization by, 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.
- xi. Embarking on deliberate exploration for gas deposits in all parts of the country.

### **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 the Kaduna Refinery, which refines imported heavy crude with similar properties.

Bitumen, which is derived 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. In this regard, government has set up the Bitumen Development Agency.

***Policy***

- i. The nation shall encourage tar sands exploration, exploitation and development for full utilisation by the country.
- ii. The exploitation of the tar sands resources shall be private sector driven, while indigenous participation shall be actively promoted.

***Objectives***

- i. To extract heavy oil from the tar sands for refineries.
- ii. To conserve foreign exchange used in importing heavy crude oil and also produce heavy crude for export.
- ii. To acquire the technology for harnessing the tar sands.
- iv. To ensure adequate financing and efficient operation and management of the sub-sector.
- v. To ensure indigenous participation in the sub-sector from the early stages of its development.

***Strategies***

- i. Undertaking exploration and exploitation activities for tar sands deposits in the country.
- ii. Establishing an appropriate regulatory institution for the tar sands sub-sector.
- iii. Putting in place necessary regulations and guidelines for the exploitation of tar sands.
- iv. Establishing infrastructural facilities for the acquisition of the technology for harnessing tar sands.

- v. Intensifying R &D in the production of lubricants and other heavy oil products from tar sands.
- vi. Establishing heavy oil upgrading facilities near the tar sands deposits.
- vii. De-emphasizing the importation of heavy crude oil as a way of encouraging the utilization of heavy oils from our tar sands.
- viii. Providing appropriate incentives to facilitate investment in the exploration and exploitation of tar sands resources.
- ix. Providing an appropriate financing facility to support indigenous investments in tar sands development.

### **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 tones while the inferred reserves are about 2.75 billion tones, consisting approximately of 49% sub-bituminous, 39% bituminous and 12% lignitic coals.

Coal mining in Nigeria started in 1906 and recorded an output of 24,500 tons in 1916. Production rose to a peak of 905,000 tons 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 to 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 14,390 tons in 2000. In 2001, coal contributed about 0.02%

to commercial energy consumption in the country, as compared to 31.9% for oil, 61.9% for natural gas and about 6.2% for hydropower.

Nigerian coal can be utilized for power generation, steam production, in cement production and for brick making; as a heat source and reducing agent for steel production; as a domestic fuel; and as feedstock for the production of chemicals, liquid fuels, gaseous fuels, batteries, carbon electrodes etc. These 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. During the last decade, joint venture arrangements with foreign partners had developed for the exploitation of some of the coal deposits. There is still the need for increased private sector, as well as indigenous, participation 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. These include creating and finding markets for the coal, increasing the productivity of the coal mines, reducing cost of production through mechanization and establishing a cost-effective transportation system through an expansion of the rail system and port facilities for the export of coal.

***Policies***

- i. The nation shall pursue vigorously a comprehensive programme of resuscitation of the coal industry.

## *Energy Sources*

- ii. Extensive exploration activities to maintain a high level of coal reserves shall be carried out.
- iii. Private sector as well as indigenous participation in the coal industry shall be activity promoted.
- iv. The exploitation and utilization of the coal reserves shall be done in an environmentally acceptable manner.

## *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.
- iii. To attract increased investment into, and promote indigenous participation in, the coal industry.
- iv. To utilize coal in meeting the critical national need of providing a viable alternative to fuelwood in order to conserve our forests.
- v. To minimize environmental pollution arising from the utilization of coal.

## *Strategies*

- i. Intensifying the drive for coal exploration and production activities.
- ii. Providing adequate incentives to indigenous and foreign entrepreneurs so as to attract investments in coal exploration and production.
- iii. Providing adequate incentives for the large scale production of coal stoves at affordable prices.
- iv. Providing adequate incentives to indigenous and foreign entrepreneurs for the establishment of coal-based industries.
- v. Developing adequate infrastructure for handling and transportation of coal within and out of the country.

- vi. Organizing awareness programmes for the use of smokeless coal briquettes as an alternative to fuelwood.
- vii. Encouraging R & D in the production, processing and utilization of coal.
- viii. Introducing clean coal technologies into coal utilization.
- ix. Re-introducing the use of coal for power generation.

### **Nuclear**

Nuclear energy is one of the major sources of base load electricity generation in the world today. The technology for harnessing nuclear energy demands great responsibility and expertise. Therefore it 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. Another nuclear science and technology centre was also established in 1993. The few trained personnel in the area are concentrated in these centres. There is therefore an urgent need to accelerate the manpower development programme in view of the diverse peaceful applications of nuclear energy.

Crucial 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 km<sup>2</sup> of land area had been covered by aerial radiometric surveys and another 90,000

km<sup>2</sup> had been covered by other surveys. Since then no further work has been done. There is the need to extend investigations to other areas of the country suspected to have traces of any of the radioactive minerals.

Uranium ores are complex assemblages of minerals and therefore differ widely in details of composition and texture. The characterization of the known uranium ore minerals in the country has been 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. In fact, it has been in use in the country for decades for various peaceful applications in health care delivery system, petroleum industry, agriculture, food preservation, animal husbandry, water resources management, pest control, industry, materials analysis, and mineral exploration. All these applications will be enhanced by the commissioning of the recently acquired nuclear research reactor and the completion of the nuclear accelerator project and the industrial irradiator. There is also the need to strengthen the recently established Nigerian Nuclear Regulatory Authority.

***Policy***

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

***Objectives***

- i. To pursue the introduction of nuclear power into the generation of electricity, in the long term.
- ii. To apply nuclear science and technology in industry, agriculture, medicine and water resources management.
- 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.

***Strategies***

- i. Intensifying manpower development in the utilization of nuclear energy for peaceful purposes.
- ii. Providing adequate resources to the Nigerian Nuclear Regulatory Authority (NNRA) for the enforcement of nuclear laws and regulations.
- iii. Intensifying research and development efforts in nuclear science and technology.
- 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 in nuclear science and technology.
- vi. Commissioning the nuclear research reactor.
- vii. Completing all the on-going nuclear related projects (e.g. accelerator and industrial irradiator projects).
- viii. Undertaking regular public enlightenment campaigns on applications of nuclear technology, nuclear safety and radiation protection.
- ix. Identifying accurately the availability and the extent of nuclear and other related mineral resources.
- x. Providing adequate funding for the development of nuclear science and technology.
- xi. Establishing a nuclear radiation surveillance programme for the protection of the environment.
- xii. Fostering co-operation with the International Atomic Energy Agency.

## **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 10MW) hydropower projects.

The total technically exploitable large scale hydropower 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 2001. The small scale hydropower potential is estimated at 734 MW. There is the urgent need to develop small 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. Hydroelectricity represented about 32% of the installed grid-connected electricity generation capacity by early 1999.

### ***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.

- iii. The exploitation of the hydropower resources shall be done in an environmentally sustainable manner.
- iv. Private sector and indigenous participation in hydropower development shall be actively promoted.

***Objectives***

- i. To increase the percentage contribution of hydro electricity to the total energy mix.
- ii. To extend electricity 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.
- v. To ensure minimum damage to the ecosystem arising from hydropower development.
- vi. To attract private sector investments into the hydropower sub- sector.

***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, in the establishment and operation of hydropower plants.
- v. Encouraging the private sector, both indigenous and foreign, for the local production of hydropower plants and accessories.

- vi. Ensuring that rural electricity boards incorporate small-scale hydropower plants in their development plans.
- vii. Promoting and supporting R & D activities for the local adaptation of hydropower plant technologies.
- viii. Initiating and updating data on the hydro potential of our rivers and identifying all the possible locations for dams.

### **Fuelwood**

Over 60% of Nigeria's population depends on fuelwood for cooking and other domestic uses. The consumption of fuelwood is worsened by 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 and the smoke is also hazardous to human health, especially to women and children who mostly do the cooking in homes.

The rate of consumption of fuelwood far exceeds the replenishing rate to such an extent that desert encroachment, soil erosion and loss of soil fertility are now serious problems in the country.

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 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.

### ***Policies***

- i. The nation shall promote the use of alternative energy sources to fuelwood.

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

***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, soil erosion and deforestation.
- iv. To facilitate the use of alternative energy resources to fuelwood.
- v. To reduce health hazards arising from fuelwood combustion.

***Strategies***

- i. Cultivating fast growing tree species needed to accelerate the regeneration of forests.
- ii. Developing appropriate technologies for the utilization of alternative energy sources to fuelwood.
- iii. Developing appropriate efficient wood stoves in the short term.
- iv. Encouraging the establishment of private and community woodlots for supply of fuelwood in the short term.
- v. Establishing micro-credit facilities for entrepreneurs, especially for women groups, for the establishment and operation of commercial fuelwood lots and the production of renewable energy devices and systems.

- vi. Developing an appropriate pricing structure to encourage substitution from fuelwood to alternative fuel types.
- vii. Ensuring the availability and effective distribution of alternative energy sources to fuelwood at all times.
- viii. Establishing training programmes on the use, maintenance and fabrication of efficient woodstoves and other alternative technologies.
- ix. Organizing systematic public enlightenment campaigns on the problems of desertification and soil erosion arising from deforestation.
- x. Ensuring the existence of effective forestry laws to stop the wilful felling of trees.
- xi. Ensuring effective enforcement of the forestry laws.
- xii. Increasing the area covered by forest reserves.
- xiii. Setting up an effective system of forest regeneration.
- xiv. Disseminating the alternative technologies to fuelwood through extension programmes, pilot plants etc.

### **Solar**

Solar radiation incident on the earth's surface varies in intensity with location, 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/m<sup>2</sup>-day in the coastal latitudes to about 25.2 MJ/m<sup>2</sup>-day in the far North. Solar energy is renewable and its utilization is environmentally friendly. Consequently, when the availability and environmental costs 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 also 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. Photovoltaic system components require more sophisticated technologies for their manufacture, particularly as regards the photovoltaic 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.

***Policies***

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

***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 the market for solar energy technologies.
- iv. To develop solar energy conversion technologies locally.

***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 production of solar energy systems.
- iv. Providing adequate incentives to suppliers of solar energy products and services.
- v. Introducing measures to support the local solar energy industry.
- vi. Setting up extension programmes to introduce solar technology into the energy mix.
- vii. Providing fiscal incentives for the installation of solar energy systems.
- viii. Setting up and maintaining a comprehensive information system on available solar energy resources and technologies.

## **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 used as fuel in thermal power plants or converted to produce solid briquettes, which can then be utilized 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.

## ***Policy***

- i. The nation shall effectively harness non-fuelwood biomass energy resources and integrate them with other energy resources.
- ii. The nation shall promote the use of efficient biomass conversion technologies.

## ***Objectives***

- i. To promote biomass as an alternative energy resource especially in the rural areas.

- ii. To promote efficient use of agricultural residues, animal and human wastes as energy sources.
- iii. To reduce health hazards arising from combustion of biomass fuel.

***Strategies***

- i. Developing extension programmes to facilitate the general use of new biomass energy technologies.
- ii. Promoting R & D in biomass energy technology.
- iii. Establishing pilot projects for the production of biomass energy conversion devices and systems.
- iv. Providing adequate incentives to local entrepreneurs for the production of biomass energy conversion systems.
- 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 systems.

**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 affect the strength and direction of the wind. The annual average wind speed at 10m heights varies from about 2 m/s in the coastal areas to about 4 m/s in the far north. It is possible to convert wind energy to rotary mechanical energy and electrical energy for a variety of uses. Wind energy has been utilized 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.

***Policies***

- i. The nation shall commercially develop its wind energy resource 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 sustainable costs to both suppliers and consumers in the rural areas.

***Objectives***

- i. To develop wind energy as an alternative energy resource.
- ii. To develop local capability in wind energy technology.
- iii. To use wind energy for provision of power to rural areas and remote communities far removed from the national grid.
- iv. To apply wind energy technology in areas where it is technically and economically feasible.

***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, developers and consumers of wind power systems.

- vi. Developing extension programmes to facilitate the general use of wind energy technology.

### **Hydrogen**

Hydrogen is the third most abundant element on the earth's surface. It is mostly found in water and organic compounds. Direct thermal, thermoelectric and electrolytic methods are so far employed in the separation of hydrogen from its carriers.

Hydrogen is an environmentally friendly combustible fuel. On combustion, it releases thermal energy and produces water as the only by-product. It is light and has good safety records during storage, transportation and utilization.

Hydrogen can be used in most thermal applications where fossil fuel is being used today. It is particularly used in fuel cells for the generation of electricity and in other thermal energy conversion systems where low weight-to-power ratio is critically required.

### ***Policy***

The nation shall integrate hydrogen as an energy source in the energy mix of the country

### ***Objectives***

- i. To keep abreast of international trends in hydrogen production and application.
- ii. To develop local production capacity for hydrogen.
- iii. To ensure hydrogen utilization as a preferred energy source, where possible, on account of its high environmental friendliness.

### ***Strategies***

- i. Encouragement of R and D in hydrogen energy related technologies.
- ii. Development of domestic capacity in hydrogen production and application technologies.

- iii. Providing incentives to popularize the use of hydrogen as an energy source.

### **Other Renewables**

Other renewable energy resources, which are not in common usage worldwide, include ocean waves, tidal energy, ocean thermal gradients, and geothermal 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.

### ***Policy***

The nation shall maintain an interest in other emerging sources of renewable energy.

### ***Objectives***

- i. To develop a database on the potentials of these emerging energy resources.
- ii. To keep abreast of international trends in energy technology development.
- iii. To ensure incorporation of any new proven cost-effective energy resource into the energy mix.

### ***Strategies***

- i. Gathering information on the development of these emerging technologies.
- ii. Encouraging R & D in the technologies of the exploitation of these emerging energy resources.
- iii. Prioritizing the level of need, level of technological development and viability of emerging renewable energy resources.

## CHAPTER THREE

### ENERGY UTILIZATION

#### *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, which is 98% owned by the Federal Government, increased by a factor of 6 over the period 1968 to 1991 and by 1991, stood at 5881.6 MW. No further addition to generating capacity was experienced over the subsequent decade. Over the years, the availability varied from about 27% to 60% of installed capacity, while transmission and distribution losses accounted for about 28% of electricity generated. In December 2001, the available generating capacity was raised to 4000 MW, but this soon dropped to 2,600 MW within the first quarter of 2002.

The annual consumption of electricity has been increasing very rapidly over the last three decades. It increased from 1,273 GWh in 1970 to 13,700 GWh in 2001. 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 estimated to be at least 50% of installed capacity of the national grid.

In recent times, the domestic sector has accounted for over 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 attract investment funds to the sub-sector, increase substantially the available installed capacity and also decrease transmission and distribution losses. These justify the on-going restructuring of the sub- sector.

***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 promote private sector participation in the electricity sub-sector, while ensuring broad-based participation of Nigerians.

***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, both foreign and domestic, for the development of the electricity industry.
- vii. To maximize access by Nigerians to the investment opportunities in the electricity industry.

***Strategies***

- i. Rehabilitating existing 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 capacity 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.
- xiv. Providing appropriate financing facilities to support indigenous investments in the electricity industry.
- xv. Encouraging off-grid generation and supply of power in remote or isolated areas.
- xvi. Establishing a Rural Electrification Fund to facilitate electrification in the rural areas.
- xvii. Establishing a reduced tariff regime for very low income and especially handicapped electricity consumers and a mechanism for funding the subsidy.

### **Industry**

The industrial sector is one of the major energy consuming sectors and it accounts for about 25% of total commercial fuels currently consumed in the country.

Inadequate and unreliable supply of energy to industry is a major contributor to low industrial capacity utilization. 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. Recent findings indicate the existence of considerable scope in the improvement of energy efficiency and conservation in the industrial sector.

***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 be used by industries.
- iii. Optimal utilization of the nation's available energy types for the various industrial activities shall be pursued in an environmentally sustainable manner.
- iv. The nation shall promote energy efficiency and conservation in industry.

***Objectives***

- i. To encourage maximum capacity utilization by industries.
- ii. To remove the burden of capital investments in energy supply infrastructure from the industries.
- iii. To ensure national security and self-reliance.
- iv. To ensure a balanced mix in the use of the nation's energy resources in the industrial sector.
- v. To ensure long term availability of the nation's energy resources through the encouragement of energy conservation practices.
- 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 as a result of industrial activities.

***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 arrangements to promote 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.

**Agriculture**

Nigeria is an agrarian country and up until the 70s, the agricultural sector formed the backbone of the nation's economy. Most Nigerian 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 has to be in proper focus. However, the growing energy needs of large-scale mechanized agriculture should also be considered.

Applications of current knowledge in key areas of nuclear, solar and other energy resource technologies 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 human and material resources and the protection of the environment.

***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 utilized judiciously and efficiently for the overall agricultural activities, with minimum harm to the environment.
- iii. The nation shall emphasize the use of affordable, adaptable, reliable and sustainable agricultural technologies, possessing flexible energy utilization capabilities.

***Objectives***

- i. To increase agricultural productivity and efficiency through the use of appropriate energy sources.

- ii. To exploit alternative sources of energy, thereby minimizing 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 the cumbersome manual methods of farming.
- iv. To develop and promote efficient technologies that would be flexible in their energy requirement.

***Strategies***

- i. Supporting research and development activities for the evolvement 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.

## **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 and minimize environmental degradation arising from energy consumption in the transport sector.

### ***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.
- iii. The nation shall ensure the use of energy efficient and environmentally friendly technologies in the transport sector.

### ***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.

***Strategies***

- i. Establishing a databank 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 into general use in the rail and road transport systems.
- iv. Maintaining adequate stocks of the various transport fuels at levels that will ensure internal fuel security.
- v. Encouraging a shift towards more energy- efficient transportation systems.
- vi. Maintaining an active interest in emerging and potentially more energy-efficient transport technologies, such as electric trains, with a view to their adoption.

## **CHAPTER FOUR**

### **ENERGY ISSUES**

#### **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 woodland reserves could be depleted within the next fifty years. These would result in negative impacts on the environment, such as soil erosion, desertification, 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. The combustion products (CO<sub>2</sub>, N<sub>2</sub>O, etc) are greenhouse gases (GHG) and lead to global warming, with attendant negative consequences on agriculture, water supply, forest resources, sea level rise, health, etc. Another source of air pollution is the continued flaring of large volumes of natural gas in the oil fields in the Niger Delta. Government has thus decided that gas flaring should stop by 2008.

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.

***Policy***

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

***Objective***

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

***Strategies***

- i. Ensuring the existence of adequate environmental standards for all major energy production, transportation, transmission and utilization operations.
- ii. Strengthening the relevant regulatory agencies in order to ensure the enforcement of appropriate set standards.
- iii. Setting appropriate targets for the attainment of definite progress in the mitigation and control of major energy related environmental problems.
- iv. Putting in place appropriate programmes to ensure the attainment of the set targets for the mitigation and control of major energy related environmental problems.
- v. Ensuring monitoring of vital environmental parameters in the production, processing and utilization of energy.
- vi. Carrying out environmental impact assessments of major energy projects.
- vii. Providing viable alternatives to fuelwood in order to minimize deforestation and decelerate the rate of desert encroachment, erosion and deforestation.
- viii. Utilizing appropriate technologies in the exploitation of the various energy resources to minimize the harmful effects on the environment.

- ix. Encouraging R & D in the optimal utilization of various energy sources to minimize the associated adverse environmental impacts.
- x. Encouraging the utilization of environmentally friendly energy sources.

### **Energy Efficiency and 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 sectors of the economy.

***Policies***

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

***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.
- vi. To eliminate avoidable investments in energy supply infrastructure.

***Strategies***

- i. Ensuring strict adherence to the regulations of the petroleum industry, and relevant agencies on energy resource exploitation and the environment.
- ii. Providing institutional arrangements and incentives 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. Ensuring the importation 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 efficiency including the development and manufacture 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.

### **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 utilization.

### ***Policy***

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

### ***Objectives***

- i. To initiate and promote energy related research and development programmes; and ensure that such programmes 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.

***Strategies***

- i. Developing and promoting local capability in the nation's Energy Centers and Research Institutes for the design and fabrication of efficient energy devices and technologies for the utilization 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.
- vi. Establishing training programmes for the development of specialized energy manpower.

**Bilateral, Regional and International Cooperation**

Nigeria is involved in bilateral, regional and international arrangements in the area 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 and multilateral cooperation arrangements with other African Countries.

The nation's membership of sub-regional, regional and international organizations such as ECOWAS, APPA, AU, UN, IAEA and OPEC provides opportunity for it to play an 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.

***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.

***Objectives***

- i. To enhance Nigeria's effective participation in international energy related organizations.
- 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 utilization of the region's energy resources.

***Strategies***

- i. Working out a co-coordinated approach to regional and sub-regional energy planning based on co-operation and consultation among member countries of ECOWAS and other members of the African Union (AU).
- 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 AU 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. Mobilizing 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 organizations.
- vii. Pooling available human resources through networking of national energy training and research centers.
- 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

#### *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 investment capital, in addition to national foreign earnings provide the greater proportion of needed funds.

Considering the risk element involved in energy projects, 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:

- i. Improvement in the financial performance of the energy supply companies in the country.
- ii. A conducive environment for investment that also protects our national interests.

#### *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 investments, both domestic and foreign, in the energy sector.

***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 attract foreign investments from a highly competitive international finance market.
- iv. To ensure that the energy supply options adopted are the most cost-effective for the country.
- v. To increase foreign exchange earnings through export of energy products
- vi. To encourage the local development of energy technology with a view to minimizing the cost input of energy projects.

***Strategies***

- i. Dedicating a certain percentage of the nation's income from conventional energy sub-sector to support training, research, development and demonstration, and technology acquisition in the energy sector.
- ii. Providing fiscal incentives for prospective investors in the energy sector.
- iii. Reviewing the existing laws and regulations for the operation of energy sector industries so as to increase private sector participation in the industries.
- 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. Encouraging energy firms to source development funds from the Nigerian capital market.
- x. Furthering the internationalization of Nigeria's Capital Market by encouraging the stocks of Nigeria's energy corporate units to be quoted in the international Stock Exchange to attract foreign portfolio investment capital.
- xi. Expanding the scope of venture capital financing to embrace investments in the energy sector.

### **Indigenous Participation**

Exploration, production and conversion activities in the energy sector are characterized by huge capital demands and advanced technology. The capital formation capability of the country's private sector and the level of domestic technological development are still low, in relation to what are needed by the energy sector. Consequently, government had played a dominant role in investments in the sector, while private sector presence, technological input and value added in energy sector activities have hitherto been overwhelmingly foreign.

As private sector participation in the energy sector is increased and government investments in the sector are privatized, the ability of the indigenous private sector, including ordinary Nigerian citizens, to participate and compete in the process should

be encouraged so as to allow for a secure and healthy development of the energy sector.

***Policies***

- i. Indigenous companies and individual Nigerian citizens shall be fully and effectively integrated into ownership participation in the deregulated and privatized energy sector.
- ii. The local content of value added in the energy sector activities shall be raised to, and maintained at, a high level.

***Objectives***

- i. To ensure effective competition of the indigenous private sector in the deregulated and privatized energy industry.
- ii. To ensure broad-based participation of Nigerians in the investment opportunities in the energy sector, especially in the privatized energy industries.
- iii. To achieve a high level of local content in the value added in energy sector activities.
- iv. To ensure a socio-economically and politically healthy and secure development of the energy sector.

***Strategies***

- i. Establishing a financing mechanism which will support indigenous investments in the energy sector industries.
- ii. Putting in place other incentives, appropriate to each energy sub-sector, which will promote indigenous private sector participation and competitiveness in the sub-sector.
- iii. Creating appropriate motivation through the Memorandum of Understanding and/or Operating Licenses in the energy sector, for increasing the local content of value added in the activities of energy sector industries.

- iv. Setting aside a significant percentage of the shares of privatized energy sector industries for acquisition by Nigerians.
- v. Putting in place schemes to ensure broad-based access by Nigerians to shares in privatized energy sector industries.
- vi. Encouraging the establishment of energy sector production and service industries by indigenous investors.

## CHAPTER SIX

### PLANNING AND POLICY IMPLEMENTATION

Energy planning and policy implementation in the country take place at four different levels. At the *National Level*, they involve macro-planning and policy implementation as part of the multi-sectoral national development policies and plans which are the responsibilities of the National Planning Commission. At the *Sectoral Level*, they involve overall sectoral planning, monitoring and co-ordination of policy implementation for the energy sector, in all its ramifications. The function ensures consistency of sub-sectoral energy policies and plans with the overall national energy policies and plans and that the implementation of the latter is in accordance with provisions. At the *Sub-sectoral Level*, more specific sub-sectoral planning and policy implementation for the development, exploitation and utilization of particular energy resources, are carried out in the various energy sub-sectors, namely oil and gas, electricity, solid minerals, etc. These involve the Ministries of Petroleum Resources, Power and Steel, Solid Minerals, and others respectively. Other energy utilization sub-sectors such as transport, industry, agriculture, as well as research and development, are also relevant. Finally, at the *Operational Level*, activities involve the execution of the policies and plans developed at the sub-sectoral level by operational establishments such as the NNPC, NEPA, Nigerian Coal Corporation and other public and private operators.

This policy document applies to issues at the Sectoral Level.

#### ***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 recognized 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 energy sector and the rest of the economy, the interactions between the sub-sectors of the energy sector itself, and the plans within each sub-sector.

***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 resource exploitation, processing, and consumption activities.
- iii. The energy plans and programmes shall be consistent with the overall national development goals.

***Objectives***

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

- vii. To provide vital input into national development planning and policy formulation.
- viii. To ensure an environmentally sustainable development of the energy sector.

***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. Ensuring that the strategic plans and programmes of the energy sub-sectors are appropriately appraised with a view to ensuring consistency with the overall national energy policy and plans and resolving conflicts arising from sub-sectoral plans and programmes.
- v. 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.
- vi. Submitting of energy data and information as may be required by the Energy Commission of Nigeria to carry out its monitoring, co-ordination and data banking functions at specified intervals, by the sub-sectoral agencies that generate or collect the primary data.
- vii. 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.
- viii. Instituting an accelerated and effective manpower development programme.

## **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 realization is often hampered by bureaucratic bottlenecks and delays. These problems have to be effectively addressed for the successful implementation of this Energy Policy.

### ***Policy***

- i. All Government energy related policies will derive from, and be consistent with, the overall National Energy Policy.
- ii. The Energy Commission shall be the focal point for the monitoring and coordination of the implementation of the national energy policy.

### ***Objectives***

- i. To ensure the effective implementation of the national energy policy.
- ii. To ensure that the energy sector plays its expected role in the realization of the goals of the national development plan.
- iii. To ensure consistency between the national energy policy and the various sub-sectoral policies on energy matters.
- iv. To ensure that there is no conflict between the various sub-sectoral energy policies.
- v. To strengthen the monitoring and coordinating functions of the Energy Commission.

***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. Prioritizing of the policy strategies for implementation, with the setting of realistic targets and effective monitoring and evaluation of the implementation process.
- iv. 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.
- v. Ensuring that approved fiscal measures, which are necessary for the achievement of set objectives of the policy, are promptly carried out.
- vi. Setting and enforcing targets about energy efficiency, energy information gathering, and fuel mix of the national energy consumption, amongst others.
- vii. Integrating energy studies into the curricula of secondary and tertiary institutions, while emphasizing their multi-disciplinary nature.
- viii. Creating regular fora for public awareness, education and participation in the realization of the goals and objectives of the energy policy.

**Prioritization of Strategies into Short, Medium and Long term.**

The implementation process of the Energy Policy 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.

### **Short Term Measures**

#### ***General***

- 1) Prioritization of the policy strategies for implementation, with the setting of realistic targets and the effective monitoring and evaluation of the implementation process.
- 2) Establishment of necessary guidelines and regulations on energy efficiency, conservation, consumption, technology, fuel mix, information gathering, etc, as appropriate.
- 3) Development and implementation of the necessary machinery for constant monitoring of the implementation of the approved energy policy and compliance with the guidelines and regulations on various energy matters by all sectors of the economy.
- 4) Ensuring the implementation of fiscal measures necessary for the achievement of the set objectives of the energy policy.
- 5) Rehabilitation of refineries, petroleum products distribution infrastructure, power plants, transmission and distribution networks.

- 6) 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 in the private and public sectors.
- 7) Increased patronage of indigenous engineering and applied research groups in the execution of projects right from feasibility studies.
- 8) 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.
- 9) Implementing energy audits 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 and industrial enterprises.
- 10) 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.
- 11) Improving the living standard of people in energy resource producing communities through the provision of socio-economic infrastructure.
- 12) Establishment of a programme for the liberalization and privatization of the energy sector.
- 13) 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.
- 14) 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.

- 15) Establishment of 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.
- 16) Intensification of action on the development of an energy masterplan.
- 17) Encouragement of interaction within existing fora for formal discussions and collaboration between institutions in the energy sector.
- 18) Enabling of private sector participation in the energy sub-sectors through the review of existing relevant laws and regulations.
- 19) Establishment of a strategy for the public awareness, education and participation in the realization of the goals and objectives of the energy policy.
- 20) 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.
- 21) 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.
- 22) 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.
- 23) Increased funding to appropriate agencies for the provision of energy related engineering infrastructure.
- 24) Easing of the constraints on the importation of essential but scarce materials for the manufacture of engineering equipment's and spares.

- 25) Submitting of energy data and information, as may be required by the Energy Commission of Nigeria to carry out its monitoring coordination and data banking functions, at specified intervals, by the sub-sectoral agencies that generate or collect the primary data.

***Oil***

- 26) Setting of medium term reserves and producibility targets.
- 27) Updating of the memorandum of understanding to ensure that it contains appropriate incentives that will attract investments in intensified crude oil exploration and development.
- 28) Maximization of petroleum production and processing efficiencies.
- 29) Improvement and promotion of the provisions put in place for the establishment of export refineries.
- 30) Ensuring the use of locally available materials such as bentonite and barytes for oil exploration.

***Natural Gas***

- 31) Review and improvement of existing incentives to producing companies to encourage them to gather and utilize associated gas in order to maximise income from associated gas and eliminate gas flaring by 2008.
- 32) Review of existing penalties for gas flaring and ensuring that they achieve the desired effect.
- 33) Establishment of appropriate arrangements to ensure the implementation of the incentives and penalties to discourage gas flaring.
- 34) Monitoring the implementation of measures to achieve the termination of gas flaring by 2008.
- 35) 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.

- 36) Provision of funding for the establishment of a nationwide infrastructure for gas gathering, transmission and distribution.
- 37) Review and sustenance of the implementation of incentives to industrial and domestic consumers to use gas or change over to gas.
- 38) Sustenance and expansion of the measures presently in place for the establishment of infrastructure and markets for the export of natural gas.
- 39) Formulation of suitable urban and regional planning regulations, which are needed for the effective distribution of natural gas to domestic and industrial consumers.

***Tar Sands***

- 40) Undertaking of more detailed geological studies, exploration and exploitation activities for the tar sands deposits of the country.
- 41) Establishing an appropriate regulatory institution for the tar sands sub-sector.
- 42) Putting in place necessary regulations and guidelines for the exploitation of tar sands deposits.
- 43) Providing appropriate incentives to facilitate investments in the exploration and exploitation of tar sands resources.

***Coal***

- 44) 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.
- 45) Provision of adequate funding to enable intensified coal exploration and production activities.
- 46) Re-introducing the use of coal for power generation.

- 47) Providing adequate incentives to indigenous and foreign entrepreneurs so as to attract investments in coal exploration and production.

***Nuclear***

- 48) Intensification of Research, Development and Training in Nuclear Science and Technology for peaceful applications.
- 49) Evolution of a rational nuclear development programme and institutional arrangements.
- 50) Strengthening of the Nigerian Nuclear Regulatory Authority to ensure Nuclear safety and Radiation Protection.
- 51) Commissioning of the pilot-scale gamma irradiation facilities for food preservation, sterilization and other industrial applications.
- 52) Commissioning the Nuclear Research Reactor.
- 53) Regular public enlightenment campaigns on peaceful applications of nuclear technology.
- 54) Intensification of exploration activities for nuclear mineral resources.
- 55) Fostering of co-operation with the IAEA through encouragement of the national counterpart agency to actively participate in all IAEA programmes.
- 56) Providing adequate resources to the Nigerian Nuclear Regulatory Agency (NNRA) for the enforcement of nuclear laws and regulations.

***Hydropower***

- 57) Constant review and improvement of multilateral agreements for monitoring and regulating the use of water in international rivers flowing through the country.
- 58) Increased patronage of indigenous entrepreneurs involved in the planning, design and construction of hydropower plants.

### *Energy Planning and Policy Implementation*

- 59) Establishment of appropriate fiscal measures as incentives to indigenous and foreign entrepreneurs for the local production of hydropower plants and accessories.
- 60) Establishment of appropriate institutional arrangements, regulations, and guidelines for the development of small-scale hydropower plants.

### *Fuelwood*

- 61) Cultivation of fast growing tree species needed to accelerate the regeneration of forests.
- 62) Development of smokeless coal, sawdust, biogas and other energy technologies as alternatives to fuelwood.
- 63) Improvement of the efficiencies and performances of existing improved woodstoves and ovens.
- 64) Encouragement of the establishment of private and community woodlots for the supply of fuelwood.
- 65) Ensuring the availability and effective distribution of kerosene as an alternative to fuelwood in the interim.
- 66) Establishing training programmes on the use, maintenance and fabrication of efficient woodstoves and other alternative technologies.
- 67) Promotional activities, such as extension and pilot projects, to disseminate solar, biogas and other alternative technologies to fuelwood.
- 68) Establishing micro-credit facilities for entrepreneurs, especially women groups, for the establishment and operation of commercial fuelwood lots and the production of renewable energy devices and systems.

### *Environment*

- 69) Organization of systematic public enlightenment campaigns on the problems of desertification and soil erosion arising from deforestation.

### *Energy Planning and Policy Implementation*

- 70) Review and enforcement of forestry laws to effectively stop the willful felling of trees in prohibited zones.
- 71) Dissemination of information on existing energy efficient and environmentally friendly technologies in the exploitation of various energy resources.
- 72) Development and implementation of guidelines and regulations on appropriate technologies for the exploitation of energy resources to minimize harmful environmental effects.
- 73) Intensification of research and development in more efficient and environmentally friendly utilization of various energy sources.
- 74) Encouragement of the utilization of environmentally friendly energy resources and technologies.
- 75) Setting appropriate targets for the attainment of definite progress in the mitigation and control of major energy related environmental problems.
- 76) Putting in place appropriate programmes to ensure the attainment of the set targets for the mitigation and control of the major energy related environmental problems.

### *Solar, Biomass and Wind*

- 77) Establishment of demonstration and pilot projects as well as holding workshops and public education campaigns on solar energy, biomass, biogas, wind and other renewable energy resources to ensure their adoption and market penetration.
- 78) Establishment of appropriate fiscal measures as incentives for the utilization of solar, wind and other renewable energy systems.
- 79) Establishment of a set of regulations and guidelines to promote and sustain the local solar, biomass and other renewable energy industries.

- 80) 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.
- 81) Providing adequate incentives to producers, developers and suppliers of solar, wind and biomass energy products and services.

***Other Renewable Energy Resources***

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

***Electricity***

- 83) Completion of on-going short term projects designed to satisfy national demand for electricity.
- 84) Expansion of the existing electricity transmission and distribution networks.
- 85) Intensification of research, development and training in alternative sources of energy for the generation of electricity.
- 86) Establishment and commencement of a programme for the liberalization and privatization of the electricity sub-sector.
- 87) Development of appropriate infrastructure, guidelines, laws and regulations for the management of a liberalized and privatized electricity sub-sector.
- 88) Commercialization of electric utility agencies and granting them managerial and financial autonomy to enable them operates efficiently.
- 89) Establishing a reduced tariff regime for very low and especially handicapped electricity consumers and a mechanism for funding the subsidy.
- 90) Review and strengthening of existing incentives for the encouragement of local manufacture of electrical equipment and devices.

## *Energy Planning and Policy Implementation*

- 91) 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.
- 92) Providing appropriate financing facilities to support indigenous investments in the electricity industry.

### *Industry*

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

### *Agriculture*

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

### *Transport*

- 96) 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.
- 97) Comprehensive study of the transport fuel distribution systems and development of recommendations for their improvement.
- 98) Initiation of discussion with relevant institutions in the transport sector to identify appropriate energy-efficient transport systems, strategies and equipment that should be introduced.
- 99) Encouragement of the relevant agencies to introduce fuel-efficient transport management systems.
- 100) Encouragement of the relevant agencies to improve and expand mass transportation and communication systems, countrywide.

***Energy Efficiency and Conservation***

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

***Research, Development and Training***

- 103) Provision of increased funding to research institutes, centers 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.
- 104) Development and implementation of a programme of R & D in energy conservation and efficiency, including the development and manufacture of energy-efficient equipment and machinery.
- 105) Promotion of the development and introduction of integrated energy and environment curricula and disciplines into the programmes of tertiary institutions.
- 106) 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.
- 107) Establishment of the necessary machinery to provide adequate funding from conventional energy sub-sectors, such as the dedication of a certain percentage of the nation's income from such sectors, to support research, development, demonstration and training in energy.
- 108) Development and initiation of the implementation of an accelerated and effective manpower development programme for the energy sector.

***Finance***

- 109) Provision of appropriate measures to encourage prospective investors in the energy sector.
- 110) Expansion of the scope of Venture Capital Financing (National Risk Fund Plc) to embrace investments in the energy sector.
- 111) Encouraging energy firms to source development funds from the Nigerian capital market.
- 112) Establishment of guaranteed and dependable repayment scheme for loans invested in energy projects.

***Indigenous Participation***

- 113) Establishing a financing mechanism which will support indigenous investments in energy sector industries.
- 114) Creating appropriate motivation through the Memorandum of Understanding and/ or Operating Licenses in the energy sector, for increasing the local content of value added in the activities of energy sector industries.
- 115) Setting aside significant percentages of the shares of privatised energy sector industries for acquisition by Nigerians.
- 116) Putting in place schemes to ensure broad-based access by Nigerians to shares in privatised energy sector industries.

**.Medium Term Measures.**

***General***

- 1) Continuation of short-term activities.
- 2) Ensuring that the strategic plans and programmes of the energy sub-sectors are appropriately appraised with a view to ensuring consistency with the overall national energy policy and plans and resolving conflicts arising from sub-sectoral plans and programmes.

### *Energy Planning and Policy Implementation*

- 3) Development of other potential sites for hydropower, gas and coal plants for electricity generation.
- 4) 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.
- 5) Establishment and sustenance of the implementation of a national energy masterplan.
- 6) Continuation of the priority given to the provision of facilities for the production of ferro-alloys and flats for the manufacturing industries.

### *Oil*

- 7) Ensuring the attainment of a reserve target of 35 billion barrels and a production capacity of 3.5 mbpd.
- 8) Commercialization of the operations of existing refineries while taking steps to promote private sector participation in the refining business.
- 9) Expansion of the transmission and storage facilities for petroleum products to achieve the 45-day strategic reserves.
- 10) Ensuring adequate geographic coverage of petroleum products distribution network.

### *Natural Gas*

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

- 15) Embarking on deliberate exploration for gas in all parts of the country.

***Tar Sands***

- 16) Continuation of detailed exploration activities and mapping *and* exploitation of the Tar Sands deposits in the country.
- 17) Providing appropriate financing facilities to support indigenous investment in tar sands development.

***Coal***

- 18) Review, improvement and effective implementation of measures for the production of coal stoves and the establishment of coal-based industries.
- 19) Establishment of smokeless coal pilot projects for the promotion of the use of smokeless coal as an alternative to fuelwood.
- 20) Introducing clean coal technologies into coal utilization.

***Nuclear***

- 21) Acquisition of nuclear research facilities and expansion of their applications in manpower training, agriculture, medicine and industry.
- 22) Completing the accelerator project and industrial irradiator.
- 23) Commencement of the exploitation of the nuclear mineral resource deposits in Nigeria.
- 24) Enforcement of Nuclear Safety and Radiation Protection Regulations.
- 25) Establishing a nuclear radiation surveillance programme for the protection of the environment.

***Hydropower***

- 26) Introduction of alternative technological options to reduce the impact of water shortage on hydropower plants.

### *Energy Planning and Policy Implementation*

- 27) Encouraging the private sector in the establishment and operation of hydropower plants.
- 28) Establishment of basic engineering infrastructure for the production of hydropower plants equipment and accessories
- 29) Establishment of mini - and micro- hydropower plants.

#### ***Fuelwood***

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

#### ***Environment***

- 33) Implementation of programmes for the attainment of set targets for the mitigation and control of major energy related environmental problems.

#### ***Solar, Biomass and Wind***

- 34) Continuation of the establishment and monitoring of renewable energy pilot projects and other overflow short-term activities.
- 35) Establishment of pilot projects to assist local entrepreneurs in the manufacture of biomass energy conversion devices.
- 36) Enabling the establishment of facilities 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***

- 37) Continuation of data gathering, storage and dissemination activities while encouraging R & D activities in the less developed renewables with a view to possible exploitation.

- 38) Prioritizing the level of need, technological developments and viability of emerging renewable energy resources.

***Electricity***

- 39) Implementation of the programme for the liberalisation and privatisation of the electricity sub sector.
- 40) Encouraging off-grid generation and supply of power in remote or isolated areas.
- 41) Establishing a Rural Electrification Fund to facilitate electrification in the rural areas.

***Agriculture***

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

***Transport***

- 44) Rehabilitation and expansion of the road, rail and river transport network as well as port facilities for the handling of coal.
- 45) 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.
- 46) Encouragement of the building of natural gas filling stations as part of road, river and rail networks.
- 47) Implementation of the approved recommendations of the study of the transport fuel distribution system.
- 48) Implementation of the approved recommendations from the investigations on the appropriate energy efficient transport systems, strategies and equipment.

***Energy Efficiency and Conservation***

- 49) 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.
- 50) Establishment of expanded use of energy efficient mass transportation and communication systems.

***Research, Development and Training***

- 51) 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.
- 52) Development, through adequate funding, of 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.
- 53) 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.
- 54) Establishing training programmes for the development of specialized energy manpower.

***Finance***

- 55) Establishment of a special risk fund scheme for the commercialization of new and emerging energy technologies, such as renewable energy technologies.
- 56) Encouraging the attraction of long-term financing from international finance institutions comprising international capital markets and brokerage firms and allowing international brokerage firms to establish and operate in Nigeria.

- 57) Encouraging the establishment of offshore banking units to attract regular inflow of off-shore funds.

***Indigenous Participation***

- 58) Putting in place other incentives, appropriate to each energy sub-sector, which will promote indigenous private sector participation and competitiveness in the sub-sector.
- 59) Encouraging the establishment of energy sector production and service industries by indigenous investors.

**Long Term Measures**

***General***

- 1) Review, improvement and sustenance of medium-term measures.
- 2) Effective Nigerianization of the personnel in the energy industries.
- 3) Review, strengthening and sustaining of the implementation of the national energy masterplan.
- 4) Full integration of renewable, nuclear and conventional energy resources into an optimal energy mix.

***Oil***

- 5) Ensuring the attainment and maintenance of a minimum crude oil and condensate reserve of 40 billion barrels and a production capacity of at least 4 mbpd.
- 6) Complete privatization of the petroleum processing industries.
- 7) Further expansion of the transmission and storage facilities for petroleum products to achieve at least 90-days strategic reserves.

***Natural Gas***

- 8) Putting in place an effective nationwide infrastructure for gas gathering, transmission and distribution, and for the export of natural gas.

***Tar Sands***

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

***Nuclear***

- 12) Planning the introduction of nuclear power into the national energy mix.
- 13) Designing, constructing and commissioning of nuclear power plants.

***Hydropower***

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

***Solar, Biomass and Wind***

- 15) Encouragement of the wide spread production and installation of renewable energy systems.

***Electricity***

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

***Finance***

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

***Environment***

- 18) Ensuring adequate environmental standards for all energy production and utilization processes.

**APPENDIX I**

***Glossary:***

<b>APPA</b>	African Petroleum Producers Association
<b>AU</b>	African Union
<b>ECOWAS</b>	Economic Community of West African States
<b>GDP</b>	Gross Domestic Product
<b>GWh</b>	Gigawatt - hours
<b>IAEA</b>	International Atomic Energy Agency
<b>kW</b>	Kilowatts
<b>Kg</b>	Kilograms
<b>km<sup>2</sup></b>	Square kilometers
<b>MJ</b>	Megajoules
<b>MJ/m<sup>2</sup>-day</b>	Megajoules per square meter per day
<b>MW</b>	Megawatts
<b>mbpd</b>	Million barrels per day
<b>NEPA</b>	National Electric Power Authority
<b>NNPC</b>	Nigerian National Petroleum Corporation
<b>OPEC</b>	Organisation of Petroleum Exporting Countries
<b>PV</b>	Photovoltaic
<b>R &amp; D</b>	Research and Development
<b>R, D &amp; D</b>	Research, Development and Demonstration
<b>R, D &amp; T</b>	Research, Development and Training
<b>tce</b>	Tonnes Coal Equivalent
<b>UN</b>	United Nations