



# **DRAFT NATIONAL RENEWABLE ENERGY AND ENERGY EFFICIENCY POLICY (NREEEP)**

**ENERGY COMMISSION OF NIGERIA**  
*Federal Ministry of Science and Technology*

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**Director General/CEO**  
Energy Commission of Nigeria

## **Foreword**

Renewable energy resource is a resource that can be re-generated through natural process within a relatively short time e.g. solar, wind, biomass, hydropower, ocean, geothermal, etc.; while Energy Efficiency is "using less energy to provide the same service". Renewable energy and energy efficiency share similar benefits to the economy: enhancing energy security in the nation through diversifying the energy supply mix; increasing energy access; creating green jobs; and protecting the environment and mitigating climate change.

It is therefore commendable that in 1992, when the Energy Commission of Nigeria (ECN) commenced drafting the first edition of the National Energy Policy, it recognized the need to incorporate the adoption of renewable energy technologies and energy efficiency best practices. The first National Energy Policy was approved in 2003 by the Federal Executive Council (FEC). Today, most foreign and local investors often sought for a separate National policy document on renewable energy and energy efficiency. Responding to this needs, the Energy Commission of Nigeria (ECN), in the discharge of its responsibility for the strategic planning and coordination of the nation's policies in the field of energy in all its ramifications, drafted the National Renewable Energy and Energy Efficiency document that addresses the entire national energy sector, namely: the electricity sub-sector, fuel sub-sector and Process heat, amongst other issues.

The resulting policy document covers the exploration, exploitation and utilization of all renewable energy sources as well as the deployment of energy efficiency and conservation technologies and best practices in the residential, commercial, industrial, transport, agriculture and building sectors of the national economy. It is hoped that this document will provide the needed framework for a better development of the renewable energy and energy efficiency for sustainable development of the national economy.

**The Honorable Minister,**  
Federal Ministry of Science and Technology  
Abuja

## ACRONYMS

AGO	Automotive Gas and Oils
CFLs	Compact Fluorescent Lamps
CO <sub>2</sub>	Carbon IV Oxide
DSM	Demand – Side Management
ECN	Energy Commission of Nigeria
EE	Energy Efficiency
ESCOs	Energy Service Companies
FEC	Federal Executive Council
FIT	Feed – in – Tariff
GDP	Gross Domestic Product
GHG	Green House Gas
GWh	Gigawatt hour
IAEA	International Atomic Energy Agency
km/fuel	kilometer per fuel
kW	kilowatt
LHP	Large Hydro Plant
MAED	Model for Analysis of Energy Demand
M J/m <sup>2</sup> -day	Mega Joule per Square metre per day
MESSAGE	Model for Energy Supply system Alternatives and their General Environmental Impacts
MW	Megawatt
NASENI	National Agency for science and Engineering Infrastructure
NCERD	National Centre for Energy Research and Development
NERC	Nigeria Electricity Regulatory Commission
NGOs	Non-Governmental Organization
₦/MWh	Naira per Mega Watt hour
PAYC	Pay As You Consume
PMS	Premium Motor Spirit
PV	Photo Voltaic
RE	Renewable Energy
REEEP	Renewable Energy and Energy Efficiency Policy
R & D	Research and Development
R, D & D	Research, Development and Demonstration
SERC	Sokoto Energy Research Centre
SHP	Small Hydro Power
SMEs	Small and Medium Scale Enterprises
S & L	Standards and Labelling
VAT	Value Added Tax
YTD	Year – to – date

## 1.0 INTRODUCTION

The forms of final energy relevant in driving the economy are electricity, fuel and process heat. Therefore, the Nigerian energy sector has the electricity sub-sector (Policy and Regulatory), fuel sub-sector (Policy and Regulatory) and others, including Research and Development. The activities of these sub-sectors all have their negative consequences on the environment, referred to as negative energy related externalities. A single Renewable Energy and Energy Efficiency Policy (REEEP) document should address the electricity sub-sector, fuel sub-sector and Process heat issues, amongst others.

The renewable energy resource is a resource that can be generated through natural process within a relatively short time e.g. solar, wind, biomass, hydropower, ocean, geothermal, etc. The Renewable Energy Policy has amongst other things, five broad objectives:

- To enhance energy security in the nation through diversifying the energy supply mix;
- To increase energy access especially in the rural and semi-urban areas;
- To facilitate employment creation and empowerment; and
- To protect the environment and mitigate climate change

Similarly, Energy Efficiency is simply "using less energy to provide the same service". Energy efficiency best practice encompasses all changes (behavioural and technological) that result in decreasing the amount of energy used to produce one unit of economic activity (e.g. the energy used per unit of GDP or value added). It is an act of avoiding unnecessary consumption of energy or choosing the most appropriate equipment to reduce the quantity and cost of energy use without decreasing individual welfare.

As energy consumption grows with increases in population and living standards, awareness is growing about the environmental costs of energy and the need to expand access to energy in a more sustainable manner. Increased recognition of the contribution renewable energy makes to rural development, lower health costs (linked to air pollution), energy independence, and climate change mitigation is shifting renewable energy from the fringe to the mainstream of sustainable development. Support for renewable energy is very high among those in government, multilateral organizations, industry, and nongovernmental organizations (NGOs) pursuing energy, environment, and development agendas at local, national, and global levels. Also, commercial markets for renewable energy are expanding, shifting investment patterns away from traditional government and international donor sources to greater reliance on private investors.

Changing investment patterns make it more important to think about markets for renewable energy that goes beyond the traditional donor agencies and governments, but also consider manufacturers, rural entrepreneurs, individual households, local technicians, NGOs, community groups, utility companies, and commercial banks. Achieving this robust investment regime requires national policies and investment framework.

## **1.2 Renewable Energy Resources and Utilization**

Nigeria is endowed with abundant fossil, nuclear and renewable energy resources. The fossil type include crude oil, natural gas, tar sands and coal; while the renewable energy resources include large hydro, small hydro, solar, biomass (fuelwood, animal wastes, agric residues, energy crops) and wind. Others are tidal and ocean waves as well as geothermal. Tables 1 and 2 show the potentials of these resources, while Table 3 shows quantitatively, energy supply and the Nigerian economy between 2003 and 2010.

Over dependence on depletable oil and gas, while totally neglecting the inexhaustible renewable energy is indeed unsustainable. Nigeria is endowed with abundant renewable energy resources that can be used in generating electricity, the significant ones being solar energy, small and large hydropower, biomass and wind. The country also has good potentials for hydrogen fuel, geothermal energy, ocean wave and tidal energy.

The annual average of daily solar radiation ranges from 3.5 kWh/m<sup>2</sup>-day in the coastal belt of the south to 7.0 kWh/m<sup>2</sup>-day in the northern arid regions, while the daily sunshine hours has an annual average of 4 to 9 hours, increasing from south to north.

Analysis of the wind pattern in the country at 10m height shows that some sites have wind regime between 1.0 to 5.1 m/s. Wind speed ranges from a low 1.4 – 3.0 m/s in the Southern areas and 4.0 – 5.12 m/s in the extreme North. Peak wind speeds generally occur between April and August for most sites. Preliminary study shows that the total actual exploitable wind energy reserve at 10 m height, may vary from 8.0 MWh/yr in Yola to 51.0 MWh/yr in the mountain areas of Jos Plateau and its is as high as 97.0 MWh/yr in Sokoto.

One of the earliest actions taken by the government of the country, in pursuit of a coherent renewable programme in Nigeria, was the establishment in the 1982/83 year, of two Renewable Energy centers, namely, the National Center for Energy Research and Development (NCERD) at the University of Nigeria, Nsukka and the Sokoto Energy Research Center (SERC) at the Usmanu Danfodiyo University, Sokoto, which are funded through the Energy Commission of Nigeria. Their activities, together with those of tertiary and other research institutions, have led to the development of a number of solar thermal, biomass and biogas devices and improved woodstoves technologies that are ready for commercial production and adoption into the national economy.

As far back as in the 1960s, more than 100 windmills for water pumping were installed in the country mainly in the North-Western, Lagos (Badagry) and Plateau (Jos) areas to provide water for human and livestock consumption. Most of these are broken down and need rehabilitation. In 1989, Katsina State ordered for 62 windmill units for water pumping.

### **1.3 Key Challenges facing the development of renewable energy sources in Nigeria**

Some of the key challenges facing the development of renewable energy sources in Nigeria include:

- Inadequate fiscal and economic incentives to attract local and foreign investment in alternative energy systems;
- Low level of public awareness on the availability and usefulness of alternative energy systems;
- Inadequate policy, regulation and institutional framework for the development and adoption of alternative energy systems - clean and renewable energy sources;
- Inadequate indigenous human capacity in the design, construction, installation and maintenance of alternative energy systems;
- Lack of capacity for the local manufacturing of alternative energy system components, resulting into limited supply and higher cost;
- Affordability: Even though renewables have low operation and maintenance costs, most renewable energy technologies have high up- front capital cost compared to their conventional energy alternatives.
- Intermittency of resource availability: An underlying barrier affecting all renewable resources is the intermittency of their availability. The challenge of energy storage and system management presents a major challenge and adds to the complexity and costs of renewable electricity.
- Standards and quality control: A major constraint to the development of the renewable energy market in Nigeria is the poorly established standard and quality control of locally manufactured and imported technologies.

### **1.4 Policy Objectives**

The policy objectives and implementation strategies have been carefully defined with the fundamental guiding premises that renewable energy and energy efficiency are crucial to national development goals and that government has a prime role in creating the enabling environment for 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 encourage the diversification of sources of energy supply through renewable energy, and as such improve the energy security of the country;*



- ii. To ensure the development of the nation's renewable energy resources and energy efficiency opportunities for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix.
- iii. To guarantee increased contribution of renewable energy and energy efficiency productive activities to national income.
- iv. 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.
- v. To guarantee an efficient and cost effective consumption pattern of energy resources.
- vi. To promote increased investments and development of the energy sector industries with private sector leadership.
- vii. To enhance technological development through increased domestic manufacturing of renewable energy and energy efficiency components;
- viii. To ensure a comprehensive, integrated and well-informed energy sector plans and programmes for effective development.
- ix. To foster international co-operation in energy trade and projects development in both the African region and the world at large.
- x. To promote research and development in, and adoption of, sustainable low carbon and clean energy technologies to mitigate environmental pollution and climate change.
- xi. To promote gender sensitivity and special attention to rural energy needs.
- xii. To promote efficiency, conservation and carbon management best practices in the nation's energy supply chain.
- xiii. To ensure effective coordination of national renewable energy and energy efficiency planning, programmes and policy implementation.
- xiv. To stimulate growth in employment generation through an expanded renewable industry;
- xv. To promote rapid expansion of renewable-based electricity market through cost reducing supply side and demand side incentives.

- xvi. To develop regulatory procedures that are sensitive to the peculiarities of renewable energy based power supply;
- xvii. To create stable and predictable investment climate in renewable energy and energy efficiency market;
- xviii. To provide effective protection of electricity consumers through effective regulation;
- xix. To reduce household and outdoor air pollution as well as contribute to the abatement of greenhouse gas emissions, and thus contribute to improved health and overall social development.
- xx. To ensure strategic market transformation from sales of inefficient energy –consuming products to massive sales of energy efficient appliances in Nigeria.

## **CHAPTER 2: RENEWABLE ENERGY POLICY**

Renewable energy is energy derived from different sources that regenerates within a relatively short period of time through natural processes. The Nigerian renewable energy resources base is enormous and these include: solar, wind, hydro, hydrogen and other renewable energy sources (geothermal, tidal and ocean waves, etc).

In twenty years, Nigeria's population is expected to double and aggregate energy demand will triple. Conventional energy sources alone will not meet the challenges of an increasing population at affordable costs and in a flexible manner. To meet the rapidly growing demand for energy, and the challenges posed by climate change there has to be a conscious effort to increasingly include renewable energy into the nation's energy mix. Renewable energy has the potential to create jobs, improve livelihoods and open up the market in rural areas. Increasing demand for rural water supply, lighting, health services and the needs of micro enterprises are already driving the market for PVs. This trend will continue to drive small hydro and wind power plants if the supporting legislative and regulatory structures are put in place.

For Nigeria, to achieve its goals of sustainable socio-economic development, the need for renewable energy cannot be overemphasized.

### **2.1 Hydropower**

Hydropower is derived from the potential energy available from water due to a difference in height between its storage level and the tail water end to which it is discharged. Despite its high initial capital cost, hydropower provides one of the cheapest and cleanest sources of electricity. Hydropower is one of the major sources of base load electricity generation in Nigeria.

Nigeria is well endowed with large rivers and some few natural falls which are responsible for the high hydropower potential of the country. The Rivers Niger and Benue and their numerous tributaries constitute the core of the Nigerian river system, which offers a renewable source of energy for large schemes. In addition, several scores of small rivers and streams do exist and can be harnessed for small schemes. Hydropower in Nigeria are generally classified as follows:

- Micro schemes:  $\leq 500$  kW
- Mini Schemes:  $500 < \text{Mini} \leq 1$  MW
- Small Hydropower:  $1 \text{ MW} < \text{Small} \leq 30 \text{ MW}$ , and
- Large hydropower:  $> 30$  MW.

The total exploitable large scale hydropower potential of Nigeria is estimated at over 14,120 MW, capable of producing 50,832 GWh of electricity annually. Only about 13.50% the nation's large hydropower potential has been developed. The Small hydropower potential of Nigeria is estimated at 3,500 MW of which only 60.58 MW which represents about 1.70% had been developed. There is the urgent need to develop Small Hydropower Plants for provision of electricity for the rural areas and remote settlements.

In Nigeria, hydropower generation capacity accounts for a significant part of the total grid electricity generation mix; and electricity production capacity from hydropower sources was 19.5% of total grid power generation capacity in Nigeria in 2012.

### ***Policies***

- i. The nation shall fully harness the hydropower potential in the country for electricity generation.
- ii. The nation shall pay particular attention to the development of the small, mini and micro hydropower schemes for the growth of the rural economy.
- iii. The nation shall exploit hydropower resources in an environmentally sustainable manner.
- iv. The nation shall actively promote private sector and indigenous participation in hydropower development.
- v. The nation shall support Research and Development activities for local adaptation of hydropower plant technologies.

### ***Objectives***

- i. To increase the contribution of hydropower to the total electricity supply mix.
- ii. To extend electricity to rural and remote areas, through the use of small, mini and micro hydropower schemes to promote economic activities.
- iii. To pursue hydropower production in an environmentally friendly and sustainable manner that minimizes the adverse impacts on the environment, ecosystem and population.
- iv. To attract private sector investments into the hydropower sub- sector.
- v. To develop local manufacturing capabilities for hydropower technologies.

### ***Strategies***

#### **Short-Term**

- i. Promoting and supporting R & D activities on hydropower exploitation for increased indigenous participation in the planning, design and construction of hydropower projects.
- ii. Establishing more hydro-meteorological stations across river basins.
- iii. Updating data on all rivers, identifying possible locations for hydropower projects and facilitating detailed survey of the potential SHP sites.

- iv. Organizing sensitization workshops, seminars and enlightenment programmes on the roles of SHP in rural development.
- v. Introducing tax reductions, soft loans, grants, bilateral concessional funding to encourage private investments and public-private partnerships in the development of hydropower projects.
- vi. Putting in place a framework for power purchase agreement between owners of SHP, the grid and users.
- vii. Exploiting the multifunctional use of hydropower infrastructure (e.g. flood control, water supply, electricity generation, recreation, etc.).
- viii. Ensuring that State Rural Electricity Boards incorporate small-scale hydropower projects in their agricultural, industrial and economic development plans.
- ix. Supporting cutting-edge research and the development of mitigation techniques and technologies to reduce or eliminate adverse impact of hydropower development and operation on the ecosystem.

#### **Medium-Term**

- x. Reviewing, improving and continuation of short-term strategies.
- xi. Establishing local training institutions to produce skilled manpower in hydropower technology.
- xii. Integrating capacity building in the procurement of hydropower projects to encourage technology transfer to indigenous personnel.
- xiii. Encouraging the private sector establishment of Indigenous Manufacturing Industries for hydropower equipment and accessories.

#### **Long-Term**

- xiv. Reviewing, improving and continuation of medium-term strategies.

## **2.2 Solar**

Solar energy is the energy that comes to the earth from the sun and is renewable from the continuing or repetitive current occurring in the natural environment. Solar radiation incident on the earth's surface varies in intensity with location, season, day of the month, time of the day, instantaneous cloud cover and other environmental factors. Nigeria lies within a high sunshine belt. Solar radiation is fairly well distributed within the country. 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. 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. Solar energy utilization is environmentally friendly, consequently when the availability and environmental costs of the utilization of other forms of energy are taken into account, the competitiveness of solar energy will be evident, particularly for low to medium power applications.

Solar radiation conversion technologies are generally either of the solar-thermal type (direct utilization of solar radiation) or of the photovoltaic (PV) type (conversion of solar radiation to electricity using semi conductor devices). Areas of application of solar thermal technologies include: crop drying, house heating, air-conditioning, preservation of foods and drugs, power generation, heating of process water for industries, hospitals etc, . On the other handsolar PV power may be utilized in low to medium power applications such as communication stations, television radio, water pumping, refrigeration etc. 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 solar power infrastructure needs to be strengthened for effective utilization of the energy resource. PV system components require more sophisticated technologies for their manufacture, particularly with regards the PV cells. However, National Agency for Science and Engineering Infrastructure (NASENI) and Sokoto Energy Research Centre (SERC) have commenced the production of solar panels in the country.

The use of solar energy technologies in Nigeria is improving especially in the areas of street-lighting, water-pumping and rural electrification. However, substantial work need to be done in the development of solar technology equipment, standards for materials, design and equipment manufacture. United Nations target for 2013 is to increase the Renewable energy usage by 50% and reduce the conventional energy source by 50%. The policies shall go in line with the Renewable Energy Master Plan to harmonize them.

### ***Policies***

- i. The nation shall aggressively pursue the integration of solar energy into the nation's energy mix, which should be based on the established potentials and available technologies nationwide.
- ii. The nation shall keep abreast of worldwide developments in solar energy technology and utilization to adopt global best practices.
- iii. The nation shall utilize solar energy resources where it is more cost effective and advantageous.
- iv. The nation shall support the establishment of local manufacturing industries for solar energy conversion technologies and applications.
- v. The nation shall effectively harness solar energy resources and integrate them with other energy resources.
- vi. The nation shall promote the use of efficient solar energy conversion technologies, such as use of photo-voltaic and concentrated solar panels for power generation.

- vii. The nation shall promote solar energy generation for productive use.

### ***Objectives***

- i. To develop the nation's capability and capacity in the utilization of solar energy.
- ii. To use solar energy as the main energy option in rural and peri-urban areas with higher solar energy potential.
- iii. To develop the market for solar energy technologies and services.
- iv. To develop local manufacture capabilities for solar energy conversion technologies.

### ***Strategies***

#### **Short-Term**

- i. Intensifying research and development in solar energy technology and applications.
- ii. Intensifying human and institutional capacity building in solar energy technologies and applications.
- iii. Providing adequate incentives to suppliers of solar energy products and services.
- iv. Providing adequate incentives to local manufacturers for the production of solar energy systems and accessories.
- v. Introducing measures to fast-track the development of local solar energy industries.
- vi. Setting up extension programmes to popularize solar energy technology and solutions to the rural and peri-urban communities.
- vii. Providing fiscal incentives for the installation of solar energy systems.
- viii. Pursuing aggressive mass campaign and advocacy on the use of RE as alternative energy sources.
- ix. Developing and enforcing standards for solar energy technologies, products, services and processes.

### **Medium-Term**

- i. Reviewing, improving and continuation of short-term strategies.
- ii. Setting up and maintaining a comprehensive information system on available solar energy resources and technologies.
- iii. Putting in place measures to leverage funding from international agencies and countries that promote the use of solar energy.

### **Long-Term**

- iv. Reviewing, improving and continuation of medium-term strategies.

## **2.3 Biomass**

Biomass is an organic, non-fossil material of biological origin. 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.

Fuelwood is solid plant biomass that is used for household heating and cooking. 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.

### ***Policies***

- 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.
- iii. The nation shall improve measures required to support a greater degree of forest thinning and the enhance collection and use of forest residues.
- iv. The nation shall enhance the demand side measures that support the use of biomass for the production of renewable energy.



- v. The nation shall set a limit on the amount of biomass use for energy, to ensure that the overall demand can be accommodated alongside other demands for land, for example, food production on biodiversity conservation.
- vi. The nation shall undertake the life cycle analysis of all biomass feedstock to determine their relative climate change benefits.
- vii. The nation shall undertake a comprehensive mapping of agro-ecological suitability for energy crops for the purpose of obtaining a regional view of production potentials and contribute to decision making on support for handling and/or processing facilities.
- viii. The nation shall incorporate waste-to-energy strategy in its overall waste management framework

### ***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.
- iv. To focus biomass utilization close to production, for community heating schemes and domestic heating, particularly off the national grid network.

### ***Strategies***

#### **Short-Term**

- 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.
- vii. Promoting of electricity and heat generation from biomass waste.

- viii. Mainstreaming waste-to-energy strategy in the overall waste management framework.

#### **Medium-Term**

- ix. Reviewing, improving and continuation of short-term strategies.
- x. Adopting measures to ensure that biomass is converted to energy in an efficient manner to maximize its benefit while at the same time to ensure that biomass is produced in a sustainable way.

#### **Long-Term**

- xi. Reviewing, improving and continuation of medium-term strategies.

### **2.4 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 nation shall de-emphasized the use of wood as a fuel 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.
- v. The nation shall ensure that harvested areas are regenerated.

- vi. The nation shall promote the commercial growing of fuel wood and improve energy efficiency in the use of fuel wood.
- vii. The nation shall promote energy conservation, efficiency and use of alternative energy sources to fuel wood.

### ***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.
- vi. To significantly reduce the quantity of particulate matter and gases emitted from fuel wood utilization, whilst of maintaining the benefit of woodfuel to ensure sustainability of natural resources.
- vii. To invest in community education/sensitization regarding benefit and disadvantages of using wood for energy.
- viii. To ensure that forest green house gas balance is maintained.

### ***Strategies***

#### **Short-Term**

- 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. Ensuring the availability and effective distribution of alternative energy sources to fuelwood at all times.
- vii. Establishing training programmes on the use, maintenance and fabrication of efficient woodstoves and other alternative technologies.
- viii. Organizing systematic public enlightenment campaigns on the problems of desertification and soil erosion arising from deforestation.
- ix. Ensuring the existence of effective forestry laws to stop the willful felling of trees.
- x. Ensuring effective enforcement of the forestry laws.
- xi. Disseminating the alternative technologies to fuelwood through extension programmes, pilot plants etc.

#### **Medium-Term**

- xii. Reviewing, improving and continuation of short-term strategies.
- xiii. Increasing the area covered by forest reserves.
- xiv. Setting up an effective system of forest regeneration.
- xv. Developing an appropriate pricing structure to encourage substitution from fuelwood to alternative fuel types.

#### **Long-Term**

- xvi. Reviewing, improving and continuation of medium-term strategies.

## **2.5 Biofuels**

The biofuel programme is a major and unique attempt at integrating the agricultural sector of the economy with the downstream petroleum sector. The benefits of biofuel include environmentally friendly fuel, additional tax revenue for the government from the economic activities of the sector, job creation, increased economic development and empowerment of the rural communities, improved farming techniques, increased agricultural research, increased crop demand, and reduction in overall Green House Gas (GHG) emissions.

The Federal Government of Nigeria in August 2005 directed the implementation of Automotive Biomass Programme for Nigeria by the Nigeria National Petroleum Corporation. Based on current demand for gasoline in the country, at 10% blending ratio with fuel ethanol, about 1.3 billion litres will be required for the country. This is expected to increase to about 2 billion litres by 2020. It is also estimated that market demand for biodiesel will be about 900 million litres by 2020 as compared to current market possibility of about 480 million litres for a 20% blend for biodiesel. The biofuel

production programme aspires to achieve 100% domestic production of biofuels consumed in the country by 2020.

### ***Policies***

- i. The nation shall improve on the link between the agricultural sector and the energy sector.
- ii. The nation shall promote the blending of biofuels as a component of fossil-based fuels in the country as required for all automotive use. The blend shall involve the process of upgrading fossil-based fuels.
- iii. The nation shall promote investments in the biofuels industry.
- iv. The nation shall grant biofuels pioneer status for an initial 10-year period with the possibility of additional 5-year extension.
- v. The nation shall support the emergence of an industry in which substantial portion of feedstock used by biofuel plants will be produced by large – scale producers and out growers.
- vi. The nation shall ensure that biofuel industry benefit from carbon credit.

### ***Objectives***

- i. To gradually reduce the nation's dependence on fossil fuels while at the same time creating a commercially viable industry that can precipitate sustainable domestic job.
- ii. To gradually reduce environmental pollution.
- iii. To firmly establish a thriving biofuel industry utilizing agricultural products as a means of improving the quality of automotive fossil-based fuels in Nigeria.
- iv. To promote job creation, rural and agricultural development, and technology acquisition and transfer.
- v. To provide a framework capable of attracting foreign investment in the biofuels industry.
- vi. To streamline the roles of various tiers of government in order to ensure an orderly development of the biofuels industry in Nigeria.
- vii. To involve the oil and gas industry in the development of biofuels in Nigeria.

## ***Strategies***

### **Short-Term**

- i. Encouraging integrated (plants and plantations) biofuels operators to set up agricultural service companies to support out-growers scheme.
- ii. Mandating biofuel producers to establish public private partnership with biofuels feedstock out-growers.
- iii. Facilitating easy market entry for intending biofuel operators through supportive regulations on biofuel activities.
- iv. Granting pioneer status-tax holiday to all registered businesses engaged in biofuels related activities.
- v. Granting 10-Year import duty waiver for biofuels equipment not produced locally.
- vi. Exempting biofuel companies from taxations, withholding tax and capital gains tax in respect of interest on foreign loans, dividends and services rendered from outside Nigeria to biofuel companies by foreigners.
- vii. Granting a single-digit interest on a preferential loan to be made available to investors in the biofuels industry to aid the development of large-scale out-growers schemes and co-located power generating plants.
- viii. Establishing agro-allied industries capable of benefiting from the incentives put in place to foster the development of the agro-allied industry in addition to other incentives.

### **Medium-Term**

- ix. Reviewing, improving and continuation of short-term strategies.
- x. Establishing a research and development fund to encourage synergy between the private and public sectors in R and D in which all biofuel companies shall contribute 0.25% of their revenue for research in feedstock production, local technology development and improved farming practices.
- xi. Persuading biofuel producers to use auditable feedstock weighing equipment and methodologies as may be prescribed.

### **Long-Term**

- xii. Reviewing, improving and continuation of medium-term strategies.

## **2.6 Wind**

The 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.
- iii. Apply global best practices in the wind energy resources and the mileage will be of achieving optimum contribution from the area of wind.

### ***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***

#### **Short-Term**

- 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. Training of skilled local craftsmen to ensure the operation and maintenance of wind energy systems.

- iv. Intensifying work in wind data acquisition and development of wind maps.
- 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.

#### **Medium-Term**

- vii. Reviewing, improving and continuation of short-term strategies.
- viii. Developing local capability through the establishment of local manufacturing in the area of wind energy technology.

#### **Long-Term**

- ix. Reviewing, improving and continuation of medium-term strategies.

## **2.7 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***

- i. 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***

##### **Short-Term**

- i. Encouragement of R and D in hydrogen energy related technologies.

##### **Medium-Term**

- ii. Reviewing, improving and continuation of short-term strategy.



iii. Development of domestic capacity in hydrogen production and application technologies.

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

**Long-Term**

v. Reviewing, improving and continuation of medium-term strategies.

**2.8 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***

i. 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***

**Short-Term**

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.

**Medium-Term**

iv. Reviewing, improving and continuation of short-term strategies.

**Long-Term**

v. Reviewing, improving and continuation of medium-term strategies.

## **CHAPTER 3: ENERGY EFFICIENCY AND CONSERVATION POLICY**

### **3.1 Overview**

There is significant potential for energy savings in the supply and demand sides of the nation's energy sector. Therefore, the sector-wide adoption of supply and demand sides' energy efficiency and conservation measures in entire energy production and utilization is imperative. Since expenditure on energy constitutes a large proportion of the country's GDP and a particularly large proportion of poor household expenditure, it is necessary to emphasize the effective and efficient use of energy. Fuel substitution is important to reduce the negative impact of the use of some fuels on the environment and to reduce the cost of energy services. For instance, substitution in the use of wood-fuel with LPG will reduce deforestation. The major sectors for energy efficiency and conservation are residential, industrial, transportation, services/commercial, agriculture and energy efficient building designs.

#### ***Policies***

- i. The nation shall adopt and promote energy efficiency and conservation best practices in the exploration and utilization of the nation's energy resources.
- ii. The nation shall mainstream energy efficiency and conservation best practices into all sectors of the economy.
- iii. The nation shall adopt appropriate energy pricing, metering, and billing mechanisms.
- iv. The nation shall integrate energy efficiency and conservation studies into the curricula of educational institutions.

#### ***Objectives***

- i. To guarantee energy access for all at appropriate costs and in a sustainable and environmentally friendly manner.
- ii. To monitor the energy use patterns of the various sectors of the economy.
- iii. To encourage end-users to adopt energy efficiency best practices, minimize energy wastages and enhance energy security.
- iv. To ensure the prudent exploitation of the nation's renewable and non-renewable energy resources.
- v. To enhance self-reliance in the prudent exploitation of the nation's renewable and non-renewable energy resources.
- vi. To reduce adverse effects of energy related activities on the environment.

vii.To increase the proportion of hydrocarbon resources available for special applications such as industrial feedstock and for export.

viii.To eliminate avoidable investments in energy supply infrastructure.

### ***Strategies***

#### ***Short-Term***

- i. Strengthening existing institutional and legal framework for the promotion of energy efficiency and conservation.
- ii. Strengthening national, regional and international collaboration on energy efficiency and conservation.
- iii. Adopting appropriate policy instruments – building standards/codes, mandatory labeling, energy use disclosure, soft loans, tax credits, investment subsidies, mandatory energy audit etc.
- iv. Conducting comprehensive energy end - use analysis in various sectors of the economy.
- v. Introducing energy audits in key sectors of the Nation's Economy.
- vi. Promoting education, information and public awareness campaign on energy efficiency and conservation best practices.
- vii. Promoting the establishment of Energy Services Companies (ESCOs).
- viii. Launching a National Demand-Side Management (DSM) initiative designed.
- ix. Providing economic, fiscal and financial incentives to promote Energy Efficiency in all sectors of the economy.
- x. Promoting research, development and adaptation of internationally available energy-efficient technologies and processes.
- xi. Introducing energy efficiency awards in all sectors of the economy.
- xii. Increasing share of green electricity by 1% every year on Year-to-date (YTB) basis compared to 2012 level.

#### ***Medium-Term***

- i. Reviewing, improving and continuation of short-term strategies.
- ii. Ensuring reduction of electricity transmission and distribution losses from the current level of 15 – 40% to under 10% by 2020.

- iii. Establishing appropriate energy efficiency regulatory and legislative framework.
- iv. Establishing guidelines for energy efficiency best practices in all sectors of the nation's economy.
- v. Designing and implementing Minimum Energy Performance Standards (MEPS) for equipment and appliances.
- vi. Designing and implementing appropriate mandatory and voluntary labelling for all energy consuming appliances.
- vii. Ensuring the certification and accreditation of Energy Auditors and Energy Efficiency Practitioners.
- viii. Integrating energy efficiency and conservation studies into the curricula of educational institutions in Nigeria.

#### **Long-Term**

- ix. Reviewing, improving and continuation of medium-term strategies.
- x. Replacing all incandescent light bulbs in every home, industry, institution and establishment in Nigeria with LEDs and other high energy saving lamps by year 2025.
- xi. Establishing a broad range of equipment energy efficiency standards and labeling by 2025.
- xii. Reducing by 2025 energy-related green house gas emissions 15% of 2013 level.

### **3.2 Residential Sector**

The Residential Sector accounts for about 56% of final energy demand in 2012. Much of this energy is consumed in the form of biomass in the rural areas, but an increasing amount of electricity is used in middle and high income homes and as the national electrification programme reaches more users. The fuelwood is burnt in inefficient traditional stoves. Improved stoves and kilns and substitution fuels (LPG, kerosene) for cooking are not extensively spread due to their cost, lack of awareness and other different socio-economic barriers. Half the urban households use electricity for lighting (using inefficient incandescent lamps) whereas the majority of rural households use kerosene, which is more expensive. Water boiling is mostly done on electric coils in urban centres, while the rural populace use fuelwood burning. Other appliances used (refrigerators, deep freezers, air conditioners, etc.) are old and mostly bought second hand and are, therefore, inefficient. Savings can be anticipated in thermal and electrical energy demand from the incorporation of energy efficiency in residential sector and from the implementation of appliance labeling and standards.

### ***Policies***

- i. The nation shall promote the use of energy efficient and environmentally friendly technologies in the residential sector.
- ii. The nation shall promote Energy efficiency standards for heating and air conditioning systems, appliances, and other plug loads such as lighting and consumer electronics in residential homes.

### ***Objectives***

- i. To combat health-sensitive indoor pollutants.
- ii. To reduce the effects of Peak Demand on power capacity.
- iii. To introduce labeling/efficiency standards for household appliances.
- iv. To introduce state-of-the-art energy-efficient technologies in residential sector.

### ***Strategies***

#### **Short-Term**

- i. Promoting the use of energy efficient domestic cookstoves in the residential sector.
- ii. Designing, promoting and implementing Minimum Energy Performance Standards (MEPS) and mandatory labelling for household energy – consuming appliances.
- iii. Raising awareness on the cost-benefits of energy efficiency in the home.
- iv. Establishing demonstration projects to encourage investment in energy efficiency measures in the residential sector.
- v. Encouraging widespread adoption of energy saving lamps e.g. Light Emitting Diodes (LEDs) and compact fluorescent lamps (CFLs) and the phasing-out of inefficient lamps e.g. incandescent bulbs.
- vi. Encouraging a shift towards modern energy services and more energy-efficient household appliances through utility end-use energy efficiency schemes such as the demand side management (DSM) techniques.
- vii. Keenly following trend in technology changes in household energy appliances to take advantage of emerging energy efficient and renewable energy technologies (e.g. solar water heaters, solar PV etc.).

### **Medium-Term**

- viii. Reviewing, improving and continuation of short-term strategies.
- ix. Incorporating energy efficient standards into the National Building Code.
- x. Establishing a framework for adoption and promotion of installation of Smart meters or Pay As You Consume (PAYC) meters in all households by 2025.

### **Long-Term**

- xi. Reviewing, improving and continuation of medium-term strategies.
- xii. Achieving by 2030 universal access to safe, clean, affordable, efficient and sustainable cook stoves/fuel switching to LPG in all households.

## **3.3 Industrial Sector**

The inefficient energy use has resulted in low performance output. The utilization of energy in Nigerian industrial sector is characterized by huge energy waste; most industries use obsolete and inefficient machines and equipment e.g. old boilers, motors, pumps, hence lowering the overall efficiency of the system. Activities on energy efficiency and conservation in industries have been limited to preliminary energy audits carried out by the government and few private entities. Also, some efforts have been directed on awareness creation among stakeholders.

### ***Policies***

- i. The nation shall promote the adoption, development and application of industrial energy efficiency and conservation best practices.
- ii. The nation shall require large, energy-intensive industries, and encourage other industrial energy users, to implement cost-effective energy savings best practices, and mandatory report annually to designate authorities.
- iii. The nation shall adopt appropriate Minimum Energy Performance Standards (MEPS for electric motors and other categories of industrial equipment, and implement portfolios of measures to address barriers to the optimization of energy efficiency in the design and operation of industrial systems and processes.
- iv. The nation shall develop and implement a package of specially designed incentives and other measures to promote energy efficiency in small and medium scale enterprises (SMEs).
- v. The nation shall over time remove energy subsidies, and internalize environmental costs, to encourage industrial energy efficiency practices.

### ***Objectives***

- i. To promote the efficient utilization of all energy types in industrial activities.
- ii. To decouple the rate of growth of industrial energy consumption from the rate of growth in industrial output.
- iii. To bring the energy intensities of industrial sectors in line with international standards and best practices.

### ***Strategies***

#### **Short-Term**

- i. Mandating industries to provide information on equipment energy performance, training initiatives, audits, technical advice and documentation, and system-assessment protocols.
- ii. Encouraging effective operational use of information flow in power factor, reduction peak load management and the use of energy efficient equipment and machinery.
- iii. Setting up and promoting Minimum Energy Performance Standards (MEPS) and Labels for electric motors and other categories of industrial equipment such as distribution transformers, compressors, pumps and boilers, etc.
- iv. Establishing of more EE and strengthening the existing testing laboratories to support national and regional EE Labeling and Standards (S&L) programmes.
- v. Setting up guidelines for implementing EE projects in the industry, as well as, guidelines for consumers and manufacturers.
- vi. Strengthening institutional framework to promote energy conservation and efficient use of energy in industries.
- vii. Providing high-quality and relevant information on proven practices for energy efficiency in industries.
- viii. Making available energy performance benchmarking information that can be easily used by industries and structured to allow international and national economy comparisons.
- ix. Encouraging investment in energy-efficient industrial equipment and processes by putting in place targeted financial incentives such as tax incentives for energy-efficient investments in industry (in particular in SMEs).
- x. Fostering public-private financing of energy efficiency upgrades in industry through risk-sharing or loan guarantees with private financial institutions and enabling the market for energy performance contracting.

- xi. Reducing specific energy consumption of key industrial outfits within the range international best practices.

#### **Medium-Term**

- xii. Reviewing, improving and continuation of short-term strategies.
- xiii.
- xiv. Identifying and assessing energy saving opportunities by benchmarking, measuring and documenting energy consumption in industries.
- xv. Implementing actions to capture identified energy-saving opportunities.
- xvi. Publicly reporting the energy-saving opportunities identified and the actions taken to capture them.
- xvii. Ensuring that energy audits are carried out by qualified personnel in industry, and the audit reports are widely promoted and easily accessible.

#### **Long-Term**

- xviii. Reviewing, improving and continuation of medium-term strategies.
- xix. Removing energy subsidies and internalize the external costs of energy through policies such as carbon pricing.
- xx. Promoting the adoption of the more-efficient industrial equipment and machinery e.g. electric motors and drives in industry with the view to achieving 50% retrofit by 2030.

### **3.4 Transport Sector**

The transport sector is the main consumer of petroleum products. Inadequate mass transport systems, poor mechanical conditions of vehicles and bad roads are some of the major factors affecting efficiency in the transport sector. Gaseous emissions from vehicles also constitute a significant portion of pollutants in towns and greenhouse gas emissions. Most of the vehicles used for transportation are mainly imported as second hand. Over the last ten years, there has been a tremendous increase in the number of vehicles.

Efficiency in the railways is also low due to inadequate maintenance and poor condition of the rolling stock and the rails on Nigeria roads.

It is widely recognized that the transport sector remains one of the most challenging areas for improving energy efficiency and while in the past, measures have focused on technological improvements, there is the need to move towards a more holistic approach, which includes reduction of transport demands, shifting to more environmentally



friendly and energy efficient modes, (e.g., substitution from passenger cars to mass transit), improving the quality or encouraging fuel mix in the transportation system, and improving the quality of transportation infrastructure.

For all modes of transport, substantial opportunities exist to improve transportation equipment. The technical savings potential for passenger cars and trucks is estimated at 15-55 percent. Energy savings in railway traffic are estimated at 10-35 percent worldwide. Significant reductions in energy use can be achieved by encouraging shifts to less energy-intensive modes of transport and urban planning.

### ***Policies***

- i. The nation shall ensure the use of energy efficient and environmentally friendly technologies in the transport sector.
- ii. The nation shall vigorously promote the development of mass transit systems.
- iii. The nation shall establish regulations to provide incentives for the purchase and use of higher-efficiency vehicles and disincentives for less-efficient vehicles.
- iv. The nation shall encourage and establish an organized and reliable public transportation system.
- v. The nation shall establish energy efficiency, fuel quality and emissions standards for vehicles.
- vi. The nation shall establish and enforce regulations, standards & codes of practice which will stimulate the supply of energy efficient vehicle technologies.
- vii. The nation shall encourage modal shift to public transport or non-motorised modes, walking and cycling, from road to rail and waterways and urban mobility planning.
- viii. The nation shall cap highway speed limit to 110Km/h or lower to save fuel and reduce vehicle emission.

### ***Objectives***

- i. To shift transport to more environmentally friendly and energy efficient modes.
- ii. To reduce energy consumption and greenhouse gas (GHG) emissions from transportation systems.
- iii. To encourage and/or enforce transport fuel efficiency in the design of public and private transport facilities.
- iv. To orient the demand towards more efficient vehicles, and encourage people to drive less.

- v. To lessen the huge reliance on private vehicles for mobility, and encourage car pooling system.
- vi. To highlight the importance of transport energy and put in place actions to develop a more energy efficient transport system.
- vii. To reduce transport-related environmental pollution and associated health problems.
- viii. To promote optimum and efficient utilization of petroleum fuels and substitution in order to reduce the nation's dependence on fuel imports, thereby releasing resources to deal with other imperatives and funding for more productive investment.
- ix. To increase public knowledge and awareness of efficiency issues in the transport industry, including specific efficiency indicators.
- x. To increase the overall energy efficiency of local, national and regional transport systems, and promote shifts of passengers and freight to more efficient modes.
- xi. To ensure that transport infrastructure is built to support the most energy efficient transport modes.

### ***Strategies***

#### **Short-Term**

- i. Embarking on Public education and information programmes on energy efficiency in transportation system.
- ii. Encouraging eco-driving techniques (training courses, awareness raising campaigns) that enable drivers to optimize their car fuel economy.
- iii. Introducing information on fuel economy and CO<sub>2</sub> emissions shown on a fuel economy label to be displayed at the point of sale of cars.
- iv. Encouraging sustainable modal shift in transportation like: motorized modes to cycling and walking; private vehicles usage to public mass transport.
- v. Energy use efficiency improvements through the use of less carbon emitting fuels, such as natural gas, as well as unleaded fuel.
- vi. Reviewing the legislative and other arrangements for public-transportation management, regulation, and monitoring.
- vii. Introducing measures to encourage the use of cleaner vehicles like labelling, taxation and infrastructure charges, grants and subsidies and scrappage schemes.

- viii. Implementing and periodically strengthening mandatory fuel-efficiency standards for light- and heavy-duty vehicles; for heavy duty vehicles this includes establishing testing procedures.
- ix. Adopting measures such as labelling, incentives and taxes to boost vehicle efficiency and accelerate the market penetration of new efficient vehicle technologies. This should include Infrastructure support and incentive schemes for very low CO<sub>2</sub>- emitting and fuel-efficient vehicles.
- x. Improving the performance of tyres, air conditioning, lighting and other non-engine components that affect vehicle's fuel efficiency, including mandatory fitting of tyre-pressure monitoring systems on new road vehicles and the introduction of energy efficiency requirements for air-conditioning systems.
- xi. Progressively increase Km/fuel ratio of automobiles on Nigeria roads by a factor each year to meet international best practices.

#### **Medium-Term**

- xii. Reviewing, improving and continuation of short-term strategies.
- xiii. Ensuring better integration between different public transport systems, walking and cycling.
- xiv. Introducing and enforcing appropriate legislation of fuel economy standards, including compulsory fitting of speed limiters.
- xv. Mandating installation of pollution control devices such as catalytic converters in vehicular exhaust emission systems and the implementation of tougher legislation relating to exhaust emissions.
- xvi. Implementing, monitoring and disseminating mandatory standards/regulations for vehicle efficiency.
- xvii. Preparing master plan to include route evaluations, costs, efficiency, parking fees including reducing the flow of traffic within city limits, and ensuring the enforcement of adopted measures.
- xviii. Introducing car purchase and circulation taxes, which are dependent on the fuel efficiency or CO<sub>2</sub> emissions of the vehicle.

### **3.5 Services/Commercial Sector**

#### ***Policies***

- i. The nation shall ensure the use of energy efficient and environmentally friendly technologies in the commercial sector.

- ii. The nation shall promote the adoption and development of energy efficiency and conservation best practices in the commercial and services sector.
- iii. The nation shall require large, energy-intensive commercial/services companies, to implement cost-effective energy savings best practices, and periodically report on their efforts to designated authorities.
- iv. The nation shall develop and adopt appropriate energy efficiency codes and standards for horizontal technologies and machineries used in the commercial sector.
- v. The nation shall adopt appropriate Minimum Energy Performance Standards (MEPS for major energy –consuming appliances and equipment.
- vi. The nation shall promote energy efficiency standards for heating and air conditioning systems, appliances, and other plug loads such as lighting and consumer electronics in commercial/services sector.

### ***Objectives***

- i. To promote a reliable and efficient use of energy with minimal negative environmental impact through the use of energy efficient technologies and gradual transition to modern energy services.
- ii. To promote the efficient utilization of all energy types in commercial/services activities.
- iii. To decouple the rate of growth of commercial energy consumption from the rate of growth in commercial activities and productivity.
- iv. To demonstrate the Government’s commitment to sustainable energy development within its own building stock.
- v. To progressively upgrade the energy performance of existing public and commercial building stock.
- vi. To achieve best practice energy performance in new public and commercial building stock.

### ***Strategies***

#### **Short-Term**

- i. Establishing minimum energy performance standards (MEPS) for energy-related equipment and appliances for the sector.

- ii. Encouraging a widespread adoption of compact fluorescent lamps (CFLs) and the phase-out of incandescent bulbs for services sector lighting in order to reduce electricity demand.
- iii. Encouraging a shift towards modern energy services and more energy-efficient services sector appliances through utility end-use energy efficiency schemes such as the demand side management (DSM) techniques.
- iv. To progressively upgrade the energy performance of existing public and commercial building stock.
- v. To achieve best practice energy performance in new public and commercial building stock.
- vi. Create framework for adoption and installation of Smart meters or Pay As You Consume (PAYC) meters.

**Long-Term**

- vii. Reviewing, improving and continuation of short-term strategies.
- viii. Equipping 50% of educational institutions and all health centres, and 15% of all hotels and agro-food industries with solar thermal heating systems to meet their hot water needs by 2025.

### **3.6 Energy Efficient Building Designs**

The nation is in the midst of unprecedented scale of building boom, with significant consequences on energy use. Today, it is estimated that commercial and residential buildings account for about one-third of the nation's final energy consumption. Industry and transport each also use about one-third of energy. However, because most buildings today do not have smokestacks, most people give little thought to their contribution to increased levels of energy use and thus air pollution.

The building sector is a major energy consumer. Unlike cars or air conditioners, buildings last decades; therefore, the way buildings are designed and constructed today will translate directly to better or worse energy efficiency in the building sector, with an impact both on the operating costs of the built environment as well as the nation's energy consumption patterns and environmental conditions for many years to come. The trend toward energy-efficient buildings is gaining momentum in Nigeria, with substantial initiatives promoting building energy efficient building designs being launched.

However, most building designs pay more attention to aesthetics with little or no concern to reduce energy use during building operation without negatively impacting occupancy comfort with respect to appropriate building orientation (having building long run on the east-west direction) to reduce solar heat gain and maximize utilization of natural ventilation.

#### ***Policies***

- i. The nation shall integrate and implement energy efficiency building designs and conservation techniques and principles into the construction of a new building and retrofitting existing ones to be more-energy-efficient.
- ii. The nation shall promote passive design techniques in building designs.

### ***Objectives***

- i. To ensure that the energy needs of buildings are met safely, efficiently and at reasonable prices.
- ii. Minimize the environmental impact of energy production and use in buildings.
- iii. Promote the efficient use and conservation of energy in buildings.

### ***Strategies***

#### **Short-Term**

- i. Establishing Building Energy Consumption Indicators and Benchmarks for buildings.
- ii. Initiating National Energy Efficiency Awards to draw public and professional attention and to encourage wider acceptance of the building energy efficiency and conservation codes.
- iii. Introducing Energy Audit Programs in Buildings.
- iv. Building Energy Consumption Databases - Energy End-Use Database.
- v. Establishing Guidelines for Energy Efficient Practices in all Government Buildings.

#### **Medium-Term**

- vi. Reviewing, improving and continuation of short-term strategies.
- vii. Integrating designs optimize the use of passive design and climatic conditions e.g. day lighting and natural ventilation.
- viii. Developing and implementing building energy-efficiency and conservation standards and codes.
- ix. Promoting the adoption of an Energy Efficiency Registration Scheme for Buildings.
- x. Introducing Green Building Standard and Certification System.

### **3.7 Agriculture**

Although agriculture is the main stay of Nigeria's economy, the sector's fuel consumption is negligible because of the largely non-mechanical nature of the sector. Therefore, energy consumption in agriculture is not usually accounted for in the national energy balance of Nigeria. However, agro-processing industries use a fairly substantial amount of fuel, including fuelwood and heavy diesel. This is normally accounted for under the industry sector.

Negligible amounts of diesel are used on the various automated farms. However, with the recent government efforts to boost mechanized farming in the country, it is anticipated that energy will play a major role not only in the processing industry but also on the modernized farms.

#### ***Policies***

- i. The nation shall promote the development and adoption of energy efficiency and conservation best practices in entire agricultural value chain.
- ii. The nation shall develop and adopt appropriate energy efficiency codes and standards for farm machineries and equipment.

#### ***Objectives***

- i. To promote the efficient utilization of all energy types in agricultural activities.
- ii. To decouple the rate of growth of agriculture energy consumption from the rate of growth in agricultural output.
- iii. To reduce energy use in agricultural practices while increasing outputs.

#### ***Strategies***

##### **Short-Term**

- i. Improving the efficiency of irrigation pump set.
- ii. Increasing the efficiency of non-pumping farm machinery.
- iii. Minimizing the need for traction through low-tillage agriculture.
- iv. Using energy-efficient equipment and machinery for post-harvest drying and storage.

## **4.0 INCENTIVES**

### **4.1 Introduction**

Incentives are essential in promoting the development of renewable energy (RE) and energy efficiency (EE) projects and programmes in Nigeria. Being new, the sub-sector faces serious difficulties in penetrating and establishing its place in the energy market; notwithstanding the fact that they could play significant role in meeting energy needs in a sustainable manner. One of the challenges include high initial cost, hence the need for some economic incentives to encourage its development.

The incentives fall under two categories, namely:

#### **i. Financial Incentives**

These include subsidies, grants etc that are targeted mostly at the demand side

#### **ii. Fiscal Incentives**

These include tax relief, duty and levy waivers, etc which are targeted mostly at the supply side.

### **4.2 Financial Incentives**

#### **(a) Soft Loans**

A percentage of the annual loans by special low interest development finance agencies should be reserved for Renewable Energy and energy efficiency projects, at interest rate not exceeding 5% p.a.

#### **(b) Subsidies and Grants**

Subsidies of up to 30% of initial costs of a RE and EE utilization facility should be granted to communities, enterprises and individuals that embark on such projects. The subsidies should however be in kind, and should be subject to due processing by the responsible administering agency, the ECN.

Examples may be found in USA, Germany, Thailand, Korea, who offer subsidies that range between 30-50%.

#### **(c) Capacity Development**

Free (sponsored) training programme should be provided for interested communities and individuals on RE and EE technologies as business ventures. Examples of such programmes are production, operation and maintenance of biodigesters, improved woodstoves and other more efficient biomass stoves, biomass briquetting machines, installation operation and maintenance of solar-PV systems, wind power generators, small-scale hydropower systems and energy –efficient products, appliances and equipment imports and manufacturing, etc.

Special funding for such programmes is to be provided, principally by government. Other local or foreign institutions/individuals may contribute to it.



### 4.3 Fiscal Incentives

These packages of incentives are targeted at producers/providers of RE and EE goods and services, such as manufacturers, corporate importers and suppliers, providers of technical services and supports.

#### (a) Lower Profit Tax

Corporate organizations that are involved in RE and EE business should pay profit tax at 50% of prevailing rate (presently 30%).

#### (b) Tax Holidays

For new companies active in RE and EE, a tax holiday should be provided for minimum of ten years of operation.

#### (c) Reduction in Import Duty

- (i) Import of materials, components and equipment by bonafide manufacturers of RE and EE devices and components. Exclusively for the manufacture of the said devices and components, should be duty free.
- (ii) Import of RE devices and components should attract import duties as indicated.

<b>PV:</b>	Modules	0%
	Module sub-assemblies and spares	0%
	Solar batteries	0%
	Inverters	0%
	Charge controllers	0%
	Solar water pumps	0%
	Solar refrigerators	0%
<b>Wind:</b>	Wind turbines	0%
	Wind turbine sub-assemblies & spare parts	0%
<b>Small –Scale Hydro:</b>	Micro-hydro turbines	0%
	Micro-hydro turbine sub-assemblies & spare parts	0%
<b>Solar Thermal:</b>	Solar-Thermal Water Heaters	0%
	Specially Selective Surfaces	0%
	Transparent Insulation	0%
<b>Biomass Energy:</b>	Processing equipments/plants	0%
<b>Energy-Efficiency:</b>	Appliances and Equipment	0%

**(d) Capital Allowance**

Investment Capital Allowance of 20% per year for the first four (4 No.) years and 19% in the 5<sup>th</sup> year, with 1% retained in the books, is to be provided.

**(e) Capital Relief**

Government should provide interest free capital relief of 50% on the initial investments to genuine manufacturers of renewable energy and energy efficient equipment, devices and systems. The relief is to be provided in kind, in the form of needed facilities for the production activities. A graduated repayment schedule of 10%, 20%, 30% and 40% of the relief in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> repayment years respectively, beginning from the second year of production, is to be specified.

An example is Czechoslovakia which provides 30% relief on initial investments for producers of solar water heating systems and EE components. The stipulated repayment schedule is 20% - 1<sup>st</sup> year, 30% - 2<sup>nd</sup> year, 40% - 3<sup>rd</sup> year.

**(f) Demand Stimulation**

It is further recommended that water heating in new government housing estates should be done with solar water heaters or biogas generators. Use of E10 and B20 in Government vehicles and generators use CFLs and other energy efficient appliances in Government buildings.

**(g) Waiver of Purchase Taxes**

Individual, Corporate or Community consumers of renewable energy and energy efficient technologies should benefit from a waiver of initial purchase taxes, e.g. VAT.

**(h) Rebates on Income Taxes and Levies**

For individuals and corporate bodies who acquire, at their own cost, renewable energy and energy efficient technologies and who are subject to income tax or community levies by government, such taxes or levies should be subject to rebate as follows:

<b>Expenditure on EE and RE Technologies</b>	<b>% Rebate on Tax/Levy</b>
Less than ₦100, 000.00	10%
₦100, 000.00 - ₦499, 999.00	15%
₦500, 000.00 - ₦5 million	20%
Greater than ₦5 million	25%

The amount of rebate, however, is limited to a maximum of 10% of amount spent on renewable energy and energy efficiency technologies.

#### 4.4 Feed-In- Tariffs

The Nigerian Electricity Regulatory Commission (NERC) introduced the FiT for Nigeria as indicated in the box below. The feed-in tariff (FIT) supports the development of new renewable power generation. FIT requires utilities to purchase renewable electricity from eligible renewable energy generators. The FIT contract provides a guarantee of payments in per megawatt hour (₦/MWh) for the electricity fed to the national grid over a guaranteed period of time. Since each renewable energy technology is unique, differentiation of FIT payments to account for these differences is considered to ensure that a variety of technologies and project sizes come on board.

##### Feed-In-Tariff

###### (i) Large Hydro Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (₦/MWh)	4,898	5,290	5,715	6,174	6,671

###### (ii) Small Hydropower (SHP)

	2012	2013	2014	2015	2016
Wholesale contract prices (₦/MWh)	23,561	25,433	27,456	29,643	32,006

###### (iii) On-Shore Wind Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (₦/MWh)	24,543	26,512	28,641	30,943	33,433

###### (iv) Solar Power Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (₦/MWh)	67,917	73,300	79,116	85,401	92,192

###### (v) Biomass Power Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (₦/MWh)	27,426	29,623	32,000	34,572	37,357

Source: NERC (2012): Multi-Year Tariff Order, 1<sup>st</sup> June 2012 – 31<sup>st</sup> May 2017

## CHAPTER 5: TARGETS/MILESTONES AND TIMELINES

### 5.1 RENEWABLE ENERGY

Nigeria has envisioned growing its economy at a rate of 11% - 13% so that it can be reckoned within the 20 largest economies in the world by 2020. Energy demand and supply studies conducted by the Energy Commission of Nigeria under various growth scenarios and taking into consideration the economic vision, demography, available energy resources and modern developmental path, using MAED and MESSAGE energy planning models of IAEA, has indicated that huge amount of energy in the form of electricity, fuel and heat would be required to meet this vision. The contribution of renewable energy towards the realization of these targets is presented through the following renewable energy programmes' activities with Targets/Milestones and Timelines:

**Table 5.1: Biomass Programme Targets**

S/ N	Activity/Item	Timeline/Quantity		
		Short Term	Medium Term	Long Term
1	Biomass Electricity (MW)	5	30	100
2	Improved Woodstoves (No.)	300,000	500,000	1,000,000
3	Biogas Digesters (No.)	500	6,000	8,000
4	Biomass Briquetting Machine (No.)	30	50	80
5	Biofuel (ML/day)* - Bio ethanol (B10) - Biodiesel (B20)	5.3 2.0	9.7 3.4	24.2 11.7

\* Based on 13% Growth rate Supply Projections of PMS and AGO.

**Table 5.2: Solar Programme Targets**

**(i) Electricity**

S/N	Activity/Item	Timeline/Quantity		
		Short Term	Medium Term	Long Term
1	Solar PV Home Systems (SHS) (MW)	5	10	15
2	Solar PV Water Pumping (MW)	50	1,000	5,000
3	Solar PV Community Services (MW)	45	500	3,000
4	Solar PV Refrigerators (MW)	20	500	2,000
5	Solar PV Street and Traffic Lighting (MW)	100	1,000	10,000
6	Solar PV Large Scale PV plants (1MW capacity)	80	990	9,990
7	Solar Thermal Electricity (1MW capacity)	300	2,136	18,127
	<b>Total (MW)</b>	<b>600</b>	<b>6,136</b>	<b>48,132</b>

**(ii) Thermal**

S/N	Activity/Item	Timeline/Quantity		
		Short Term	Medium Term	Long Term
1	Solar Water Heaters (No.)	4,000	60,000	150,000
2	Solar Cookers (No.)	2,000	50,000	150,000
3	Solar Dryers (No.)	150	2,000	6,000
4	Solar Stills (No.)	100	3,000	2,000
5	Solar Pasteurizers (No.)	300	4,000	10,000

**Table 5.3: Hydropower Programme Targets**

S/N	Activity/Item	Timeline/Quantity		
		Short Term	Medium Term	Long Term
1	Large Hydropower (MW)	4,000	9,000	11,250
2	Small Hydropower (MW)	100	760	3,500
	<b>Total (MW)</b>	<b>4,100</b>	<b>9,760</b>	<b>14,750</b>

**Table 5.4: Wind Programme Targets**

S/N	Activity/Item	Timeline/Quantity		
		Short Term	Medium Term	Long Term
1	Wind Electricity (MW)	23	40	50
2	Windmill Water Pumping Systems (No.)	20	100	200

**Table 5.5: Summary of Renewable Energy Targets**

**(i) Renewable Electricity Supply Projection in MW (13% GDP Growth Rate)<sup>1</sup>**

S/N	Resource	Now	Short Term	Medium Term	Long Term
1	Hydro (LHP)	1938	4,000	9,000	11,250
2	Hydro (SHP)	60.18	100	760	3,500
3	Solar PV	15.0	300	4,000	30,005
4	Solar Thermal	-	300	2,136	18,127
5	Biomass	-	5	30	100
6	Wind	10.0	23	40	50
	All Renewables	1985.18	4,628	15,966	63,032
	All Energy Resources	8,700	47,490	88,698	315,158

<sup>1</sup>CBN, NPC

Short Term: 2013 – 2015; Medium Term: 2016 – 2020; Long Term: 2021 - 2030

	(installed capacity 2012)			
% of Renewables	23%	10%	18%	20%
% RE Less LHP	0.8%	1.3%	8%	16%

\*From Supply Projections based on 13% GDP growth

## (ii) Non-Electricity (Thermal)

Activity/Item	Timeline/Quantity		
	Short Term	Medium Term	Long Term
Total thermal Energy Production (GWh)	193,709	202,128	248,809
Renewable Energy Share (%)	85	80*	79*
Other non-renewable Share (%)	15	20	21

\* Note that the decline over the years is due to the planned decrease in the consumption of fuelwood

## (iii) Fuels (bio fuels) Targets\*

Item	Timeline/Quantity		
	Short Term	Medium Term	Long Term
Bio Ethanol (E10)	1935	3541	8833
Bio-diesel (B20)	730	1251	4271

\* Based on 13% GDP growth

## 5.2 ENERGY EFFICIENCY

The global goal or target for energy efficiency set in the Sustainable Energy for All initiative is doubling the rate of improvement in energy efficiency. This implies increasing the current pace of energy efficiency improvement in all sectors of the nation's economy to 2.5 percent per year, achieving a 40 percent reduction in the amount of energy consumption by 2030, measured in terms of energy intensities. For us as a nation, specific targets may include:

- Production of guidelines on all the key components of EE by 2020;
- Enactment of all relevant legislation required for policy implementation by 2020;
- Attain replacement of 40% (by 2020) and 100% (by 2030) of old and inefficient appliances in Nigeria with energy efficient appliances;

- Review and improve on the recommended EE practices by 2016;
- Sustain best EE practices beyond 2030

## **6. CONCLUSION**

The renewable energy and energy efficiency policies for the provision of electricity, fuels and heat, and their targets and timelines in the short, medium and long terms are provided. Specific policies, objectives and strategies for renewable energy and energy efficiency are clearly stated in Chapter 2 and 3 respectively. These policies when fully implemented would facilitate the attainment of the targets within the timelines. Incentives for the promotion of renewable energy and energy efficiency are articulated in the fourth chapter, while the targets are presented in the fifth chapter.

It is projected that renewable electricity is to contribute about 20% of the total electricity supply in the nation; while renewable fuels (bio-fuels) is to meet 10% - 20% of the national fuel supply. Biomass, and indeed fuel-wood, would continue to play significant role in meeting the domestic heat requirements. However, dependence on fuel-wood is expected to decline over the years. Similarly, energy efficiency and conservation best practices will continue to form the cornerstone in meeting the nation's energy needs for the attainment of the Vision 20-2020 and beyond.

## **References**

1. National Energy Policy