RENEWABLE ENERGY MASTER PLAN

REVISED EDITION

ECN **UNDP**

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Contents

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Foreword

The development of renewable energy is central in the National Energy Policy as well as the National Energy Master Plan (NEMP). Renewable energy reduces sole dependence on fossil fuels and thus improves security of energy supply, reduces greenhouse gas emissions creating environmental and social benefits, while delivering green jobs to the economy. The Renewable Energy Master Plan (REMP) sets out in the short, medium and long terms within the national energy supply mix as well as articulate strategic approach and measures to meet the targets.

The Nigerian government's commitment to accelerating the development of renewable energy in the country is set out in the National Energy Policy and the Vision 2020-20. For Nigeria to be among the twenty (20) largest economies in the world by 2020, adequate and reliable energy supply, climate change mitigation and adaptation and creation of employment, which are inter-related challenges, must be addressed through the transformation of Nigeria's economy from one based mainly on fossil fuel to a low carbon economy based around renewable energy and energy efficiency.

Government's ambitions for renewable energy and the related national targets are in line with global quest for a long term energy security and clean environment for sustainable development.

An interrelated and integrated approach, involving all relevant public sector Ministries, Departments and Agencies in all tiers of government and the private sector will be critical for delivery of this plan over the next decade. In setting out to achieve a significant transformation of the energy landscape, Government recognizes the strategic role of the public and private sectors in supporting the new infrastructure required to deliver change. This challenge will need to be progressively addressed in the course of the implementation of the REMP.

This REMP is therefore a roadmap for actualization of Government's commitment to create the necessary enabling environment for sustainable energy supply for national development with active participation of the private sector. It is divided in to programmes with targets, timelines and activities. Incentives to promote the attainment of the programmes as well as generally grow the renewable energy market are also provided. Some risks have been identified and highlighted.

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Acronyms

AC	Alternating Current
ADP	Agricultural Development Programme
AfDB	African Development Bank
APPA	African Petroleum Producers Association
ARCEDEM	African Regional Centre for Engineering Design and Manufacture
ASDB	Asian Development Bank
ASL	Above Sea Level
AU	African Union
BOI	Bank of Industry
CASHPP	Capital Alliance for Small Hydro Power
CBN	Central Bank of Nigeria
CDA	Caribbean Development Authority
CO_2	Carbon dioxide
DC	Direct Current
DPR	Department of Petroleum Resources
DPs	Development Partners
DTCD	Department of Technical Cooperation for Development
ECN	Energy Commission of Nigeria
ECOWAS	Economic Community of West African States
EIA	Environmental Impact Assessment
EIA	Energy Information Administration (US Department of Energy)
EMV	Expected Monetary Value
ERCs	Energy Research Centres
FAO	Food and Agricultural Organization
FCT	Federal Capital Territory, Abuja
FEPA	Federal Environmental Protection Agency
FIRS	Federal Inland Revenue Service
FMA & RD	Federal Ministry of Agriculture and Rural Development
FMAv	Federal Ministry of Aviation
FMoD	Federal Ministry of Defence
FMEd	Federal Ministry of Education
FMEnv	Federal Ministry of Environment
FMF	Federal Ministry of Finance
FMH&UD	Federal Ministry of Housing & Urban Development
FMoI	Federal Ministry of Information
FMJ	Federal Ministry of Justice
FMoN-D	Federal Ministry of Niger Delta
FMoP	Federal Ministry of Power
FMST	Federal Ministry of Science and Technology
FMT&I	Federal Ministry of Trade and Investment
FMW&SD	Federal Ministry of Women Affairs and Social Development
FMWR	Federal Ministry of Water Resources
FMYD	Federal Ministry of Youth Development
FORMECU	Forestry Monitoring and Evaluation Coordinating Unit
GEF	Global Environmental Facility
GJ	Giga Joule (Giga = 10^9)
GW	Gigawatt
GWh	Gigawatt-hour

Ha	Hectares
HGS	High growth scenario
IAEA	International Atomic Energy Agency
ICRC	Infrastructure Concession Regulatory Commission
IC – SHP	International Centre for Small Hydro
IDB	Inter-American Development Bank
IMF	International Monetary Fund
IPP	Independent Power Producer
ITF	Inter-Tropical Front
Kg	Kilogramme
kJ	Kilojoule
Km/h	Kilometre/hour
kW	Kilowatt
KWh/m^2	Kilowatt hour per square meter
kWh	Kilowatt-hour
LHP	Large Hydro Power
LGA	Local Government Area
LGS	Low growth scenario
M	Metre
M^3	Cubic Metre
M^3/s	Cubic Meter per Second
MAED	Model for the Analysis of Energy Demand
MAN	Manufacturers Association of Nigeria
MCM	Million Cubic Meters
MESSAGE	Model for the Energy Supply Strategy Alternatives & their General Environmental Impact
MFO	Market Facilitation Organization
MJ	Megajoule
MOU	Memorandum of Understanding
MPR	Ministry of Petroleum Resources
MToe	Million Tons of oil equivalent
MW	Megawatt
MWh	Megawatt-hour
NACCIMA	Nigerian Assoc. of Chambers of Commerce, Industry, Mines & Agric.
NAPEP	National Poverty Eradication Programme
NAPTIN	National Power Training Institute of Nigeria
NARICT	National Research Institute for Chemical Technology
NASENI	National Agency for Science and Engineering Infrastructure
NASS	National Assembly
NBRRI	National Building and Roads Research Institute
NBS	National Bureau of Statistics
NBTE	National Board for Technical Education
NCAM	National Centre for Agricultural Mechanization
NCCE	Nigerian Commission for Colleges of Education
NCERD	National Centre for Energy Research and Development
NDE	National Directorate of Employment
NEEDS	National Economic Empowerment and Development Strategy
NEP	National Energy Policy
NEPA	National Electric Power Authority
NEPAD	New Partnership for African Development

NERC	Nigerian Electricity Regulatory Commission
NERDP	New Energy Research and Development Programme
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGO	Non Governmental Organization
NIMET	Nigerian Meteorological Agency
NIMOR	Nigerian Institute of Marine and Oceanographic Research
NIPC	Nigerian Invesment Promotion Commission
NIREDA	Nigerian Renewable Energy Development Agency
NNPC	Nigeria National Petroleum Corporation
NNRA	Nigerian Nuclear Regulatory Authority
NOA	National Orientation Agency
NPC	National Planning Commission
NRSE	New and Renewable Sources of Energy
NUC	National Universities Commission
NYSC	National Youth Service Corps
O & M	Operation and Maintenance
OPEC	Organization of Petroleum Exporting Countries
OTEC	Ocean Thermal Energy Conversions
PJ	Picojoule
PSP	Private Sector Participation
PTDF	Petroleum Technology Development Fund
PV	Photo Voltaic
RBDA	River Basin Development Authority
REA	Rural Electrification Agency
RIs	Research Institutes
R&D	Research and Development
REMP	Renewable Energy Master Plan
RET	Renewable Energy Technology
RMRDC	Raw Materials Research and Development Council
RS	Reference scenario
SASSs	State Assemblies
SERC	Sokoto Energy Research Centre
SGs	State Governments
SHESTCO	Sheda Science & Technology Complex
SHP	Small Hydro Power
SHS	Solar Home Systems
SMEDAN	Small and Medium Enterprises Development Agency of Nigeria
SON	Standard Organization of Nigeria
TIs	Tertiary Institutions
TJ	Terajoule
Toe	Tons of oil equivalent
TPES	Total primary energy supply (demand)
TW	Trillion Watt
TWh	Trillion Watt Hour (Tera -10^{12})
UEMOA	Economic and Monetary Union of West Africa
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Program
UNESCO	United Nation Educational Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization

Executive Summary

The first draft of the Renewable Energy Master Plan (REMP) was produced in 2005 under the sponsorship of the United Nations Development Programme (UNDP). It has since created greater awareness on the benefits of renewable energy and its technologies. Greater contribution of renewable energy into the nation's energy supply mix for sustainable socio-economic development has since began to be achieved at both federal and state levels.

However, seven years down the line, new policy guidelines and developments have taken place both locally and internationally. Secondly, the first edition was voluminous and needed to be concise and precise. This 2nd draft edition has therefore concentrated on concisely bringing out the renewable energy programmes of biomass, solar energy, hydropower, wind, emerging technologies and framework programmes with targets and timelines in the short (2013-2015), medium (2016-2020) and long term (2021-2030). The framework programme presented as action plan has articulated activities that are common to the other programmes and ensures that the activities are mutually supportive.

Economic and financial incentives required to specifically reduce the initially high investment cost of renewables and generally enhance penetration into the nation's energy supply mix are proffered.

Finally, a risk analysis of factors that may stifle the activities in the action plan for attainment of the set targets are also provided. On the long term, renewable electricity is expected to contribute about 20% to the total electricity supply in the country; while the national fuel supply is to be supported by 10% - 20% renewable fuels (biofuels). Dependence on fuelwood as a source of fuel for cooking and heating is to decline over the years.

1.0 INTRODUCTION

1.1 Introduction

Renewable energy is energy derived from a source that regenerates itself within a relatively short time through natural process. This document is the revised version of the 1st draft Edition of the Renewable Energy Master Plan (REMP). In 2005, the United Nations Development Programme (UNDP) supported the Energy Commission of Nigeria (ECN) to produce the Renewable Energy Master Plan (REMP) for Nigeria to remove common barriers to renewable energy development in Nigeria. Greater awareness on the benefits of renewable energy and its technologies has since been created. To this effect, greater contribution of renewable energy into the nation's energy supply mix for sustainable socio-economic development has been achieved.

However, seven years after the 1st draft Edition of the Renewable Energy Master Plan was produced, many developments have taken place within Nigeria and even globally. Secondly, the 1st Edition was voluminous and needed to be appropriately trimmed and made precise.

1.2 Energy Resources, Energy Supply and the Economy

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.

Table 1: Fossil Energy Resources and Nuclear Energy Sources

S/N	Resource	Reserves	Production (2010)	Domestic Utilization (2010)
1.	Crude Oil	37 billion barrels	0.896 billion barrels	0.164 billion barrels
2.	Natural Gas	187 Tscf	2.392 Tscf	75.7% - Fuel, Industries, re-injection and gas lift. 24.3% - gas flare
3.	Coal	2.7 billion tonnes	0	Negligible
4.	Tar Sands	31 billion barrels of oil equivalent	0	0.224 million tonnes
5.	Nuclear	Yet to be quantified	0	30kW experimental nuclear reactor

Source: NNPC (2010), CBN (2010)

Table 2: Renewable Energy (RE) Potentials

Resource	Potential	Remark
Large Hydropower	11,250 MW	1900 MW exploited
Small Hydropower	3,500 MW	64.2 MW exploited
Solar	4.0 kWh/m^2/day - 6.5 kWh/m^2/day	15 MW dispersed solar PV installations. (estimated)
Wind	2-4m/s @ 10m height mainland	Electronic Wind Information System (WIS) available; 10 MW wind farm in Katsina in progress.
Biomass (non-fossil organic matter)	-Municipal waste -Fuelwood	- 18.5 million tonnes produced in 2005 and now estimated at 0.5kg/capita/day - 43.4 million tones/yr fuelwood consumption
	Animal Waste	245 million assorted animals in 2001
	-Agric Residue -Energy crops	-91.4 million tonnes /yr produced -28.2 million hectares of arable land; 8.5% cultivated

Source: REMP (2005) and FMEnv.

Table 3: Energy Supply and the Nigerian Economy

S/N	Items	2003	2004	2005	2006	2007	2008	2009
1.	Electricity Generation (billion kWh)	22.03	23.9	24.22 (503)* (10,695)**	23.8	23.3	21.27 (562)* (18,603)**	20.8
2.	Energy Consumption per capita (Kgoe/Capita)	151.3	125.5	132.6 (680)* (1,780)**	87.1	81.4	80.8 (670)* (18,603)**	83.1
3.	Electricity Consumption per capita (kWh/Capita)	174.6	176.4	181.4 (563)* (2,596)**	167.6	161.2	142.9 (571)* (2,782)**	135.2
4.	GDP per capita (US$/Capita)	620.7	658.0	826.3 (2,314)* (8,492)**	1030.3	1223.5	1,286.3 (2,540)* (9,550)**	1,106.8
5.	Energy Intensity (Kgoe/US$)	0.244	0.191	0.161 (0.294)* (0.210)**	0.085	0.067	0.063 (0.264)* (0.192)**	0.075
6.	GDP Growth Rate (%)	9.6	6.6	6.5	6.0	6.5	6.0	6.7

Source: CBN (2005 - 2010), NCC Osogbo (2009),
*Africa Average – IEA (2007, 2010),
**World Average – IEA (2007, 2010)

1.3 Drivers of Renewable Energy Development in Nigeria

Interest in the use of alternative energy in the form of renewable energy has increased substantially because of its potential to long term sustainable energy supply for the economy, since petroleum may not last beyond 80 years at the 2010 rate of production and reserves. There are also substantial environmental benefits in reduced GHG emissions as compared with conventional energy sources. Renewable energy has great potentials for job and employment creation.

1.4 Objectives of the Renewable Energy Master Plan

The specific objectives of the Renewable Energy Master Plan are to:

- Enhance national energy security;
- Expand access to energy especially in the rural areas;
- Stimulate employment, economic empowerment and growth and reduce poverty;
- Increase the scope and quality of rural services, including, schools, health services, water supply, information, entertainment and stemming the migration to urban areas;
- Reduce environmental degradation and health risks, particularly to vulnerable groups such as women and children;
- Improve learning, capacity-building, research and development on various renewable energy technologies in the country; and

1.5 Overview of the 1st Edition of the REMP

Contents and Structure

The first version of the Renewable Energy Master Plan (REMP) is a 235 – page booklet, broadly divided into three sections – Executive Summary, Main Body and Annexes. The main body consists of six chapters, 52 tables and 13 figures. It has several annexes and references.

1.5.1 Chapter 1: The first chapter is the introduction, which highlights the rationale for, vision and objectives of REMP, under the following sub-headings: the Energy Situation in Nigeria; Development and Energy Challenges; Drivers for change; Rationale for the REMP; Nigeria's Renewable Energy Vision; Objectives of the REMP; and Expected Outputs.

1.5.2 Chapter 2: The second chapter focused on the Renewable Energy Resources, Technologies and Markets. This Chapter considered each renewable energy resource in this order: Hydro power, Solar, Biomass, Wind, Hydrogen Cell, Marine, Ocean and Geothermal Energy. For each renewable energy source, the chapter considered the resource base, status of data availability including its adequacy and gaps. Also, overview of the various technologies in each renewable energy type was extensively discussed. The market situation and the comparative international experiences were discussed in details, as well as the gaps and barriers to the development of each renewable energy technology market.

1.5.3 Chapter 3: Targets

Targets are critical tools in achieving the vision of the REMP. Since the major areas for the utilization of renewable energy are electricity, automotive fuel production and other thermal or heat production (cooking, heating, drying, etc.), targets were set for RE in the short (2005 – 2007), medium (2008 – 2015) and long (2016 – 2025) terms, guided by the energy demand and supply projections for the nation, produced by the Energy Commission of Nigeria, under various economic growth rates or scenarios from the reference or base.

1.5.4 Chapter 4: Planned Activities and Milestones

To ensure that the REMP targets outlined in chapter 3 were achieved, concrete activities and milestones were identified in the short, medium and long term. These activities and milestones were organized under specific sub-sectoral programmes: Framework Programme on Renewable Energy Promotion, National Biomass Energy Programme, National Solar Energy Programme, National Small Hydro Energy Programme, National Wind Energy Programme and Emerging Energy Research and Development Programme.

The action plan was presented in tabular form featuring: Activity Area, Project, Description of activities, Year and Estimated cost and participating agencies. These activities are grouped into the short-term (2006 – 2007), Medium term (2008 – 2015) and Long-term (2016- 2025).

1.5.5 Chapter 5: Strategy and Implementation Issues

Key strategic implementation issues discussed in this chapter included Policy, Legal and Regulatory Framework; Institutional Framework; Economics and Financing; Capacity Building; Public Awareness; Inter-Agency Collaboration (including public-private partnership); Research and Development and Monitoring and Evaluation.

1.5.6 Chapter 6: Risk Identification and Analysis

This section discussed potential risk factors that may hinder the implementation of the REMP, which included Policy and Political risks; Market risks, Standards and Quality Control risks; Research and Development risks; and Environmental risks.

It is stressed that the identification and analysis of these risks will allow stakeholders in the renewable energy economy to factor in these risks, or seek alternative approaches to reaching national renewable energy targets and objectives.

1.6 Overview of Renewable Energy and Related Policies and Regulations in Nigeria

The main constraints in the rapid development and diffusion of technologies for the exploitation and utilization of renewable energy resources in the country are the absence of market and the lack of appropriate policy, regulatory and institutional framework to stimulate demand and attract investors. The comparative low quality of the systems developed and the high initial upfront cost also constitute barriers to the development of markets. Therefore, to unleash the enormous potential of its renewable energy resources

on its drive to achieve the MDG's and NEEDS targets, the Federal Government of Nigeria has formulated many renewable energy related policies, namely:

- National Energy Policy, which contians renewable energy, initiated by the Energy Commission of Nigeria and approved by the Federal Government in 2003.
- Draft Renewable Energy Electricity Policy initiated by the Federal Ministry of Power in 2006.
- Nigerian Biofuels Policy Incentives initiated by the NNPC and approved by FEC in 2007.
- Vision 20-2020 Document initiated by National Planning Commission and approved by FEC in 2012.
- National Climate Change Policy initiated by the Federal Ministry of Environment and approved by FEC in 2011.
- National Environmental Regulations (2009, 2011) initiated by the National Environmental Standards and Regulations Enforcement Agency (NESREA)
- Electric Power Sector Reform (EPSR) Act of 2005, which libelarized the electricity sector, unbundled the PHCN in preparation to its privitization, and established the Nigerian Electricity Regulatory Commission (NERC) as the sector regulator.
- Regulation on Independent Electricity Distribution Networks (IEDN) and Embedded Generation initiated by NERC.
- Feed- In- Tariff for electricity from renewable energy sources initiated by NERC.

2.0 RENEWABLE ENERGY PROGRAMMES AND TARGETS

2.1 Renewable Energy Programmes

The Renewable Energy Master Plan (REMP) is basically structured into the following programmes with short (2013–2015), medium (2016–2020) and long term (2021–2030). The programme under the Master Plan includes:

- National Biomass Energy Programme
- National Solar Energy Programme
- National Hydropower Programme
- National Wind Energy Programme
- Emerging Energy Programme
- Framework Programme for Renewable Energy Promotion

The Framework programme articulates issues that are common to all other sub-sectoral programmes and ensures that activities within the sub-sectors are mutually supportive, e.g,

- Legal, Regulatory and Institutional framework
- Incentives (Financial and Fiscal)
- Capacity Building (Human and Infrastructural)
- Inter-Agency/Governmental Collaboration
- Research and Development
- Monitoring and Evaluation
- RE Portfolios and Feed-in-Tariff

2.2 Energy Demand and Supply Projections for Nigeria

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 following growth scenarios were considered:

- **Reference Growth Scenario:**
  - GDP grows by an average of 7% per annum
  - The main driver of growth is the manufacturing sector
  - Manufacturing accounts for 15% of GDP by 2020 from 4% in 2011
  - Consistent with the MDG objective of reducing poverty by half by 2015
- **High Growth Scenario:**
  - GDP grows by an average of 10% per annum
  - Manufacturing contributes 22% to GDP by 2030 from 4% in 2011
  - Nigeria is transiting from an agrarian economy to an industrializing nation

- **Optimistic Growth Scenario:**
  - GDP grows by an average of 13% per annum
  - Manufacturing contributes 22% to GDP by 2030 from 4% in 2011
  - Nigeria is transiting from an agrarian economy to an industrializing nation

Table 4: Projected Access to Grid Electricity by Household for Nigeria

Scenario	2010	2015	2020	2025	2030
Reference growth (7%)	60	75	80	85	90
High growth (10%)	72	86	93	94	95
Optimistic growth (13%)	72	86	93	94	95

Table 5: Electricity Demand Projections per Scenario, MW

Scenario	2009	2010	2015	2020	2025	2030	2035	2040
Reference growth (7%)	4,052	7,440	24,380	45,490	79,798	115,674	161,651	213,122
High growth (10%)	4,052	8,420	30,236	63,363	103,859	196,875	333,444	487,510
Optimistic growth (13%)	4,052	10,230	41,133	88,282	170,901	315,113	573,289	979,326

Table 6: Projected Total Energy Demand for Fuel Petroleum Products for Nigeria (Million Litres)

Year	PMS		DPK		AGO		Fuel Oil		LPG	
	7%	13%	7%	13%	7%	13%	7%	13%	7%	13%
2009	5096.94	5096.94	356.06	356.06	565.64	565.64	120.01	120.01	74.16	74.16
2010	6180.00	8890.00	464.00	902.00	791.68	1177.85	160.00	270.00	93.20	132.90
2015	14460.00	19510.00	3788.00	7039.00	2301.86	3651.10	1800.00	3380.00	1107.00	1871.20
2020	28170.37	35587.13	9038.71	22704.49	4176.76	6270.84	4632.07	9277.93	2862.50	5733.51
2025	39769.44	55459.38	15984.94	44285.43	6231.84	11408.42	7806.10	20797.42	4823.96	12852.25
2030	56457.15	88369.15	22064.93	77255.68	8902.43	21349.73	11374.64	45443.40	7029.22	22903.70

Table 7: Projected Electricity Supply by Fuel Type Based on 13% Economic Growth Rate (MW)

	2009 (Based Yr)	2010	2015	2020	2025	2030
Coal	0.00	3352.98	3352.98	12,121.79	14,011.27	20398.63
Electricity Import	0.00	0	0	0	0	67727
Gas	3803.00	13109.77	26426.06	49,996.47	120,512.45	164,306.85
Hydro	1930.00	4157	11207.00	12132	12132	12132
Nuclear	0.00	0.00	3599.99	7199.99	7199.99	7199.99
Small Hydro	20.00	105	319.9	759.85	1660.05	3502.1
Solar	0.00	490.35	2543.30	6417.27	15969.94	39737.5
Wind	0.00	23	36	41	47	54
Biomass	0	0	5	30	65	100
Supply	5746.00	21,238.09	47,490.24	88,698.37	171,597.69	315,158.07

2. 3 Renewable Energy Targets/Milestones and Timelines

The renewable energy programmes' activities with Targets/Milestones and Timelines are as follows:

Table 8: 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 9: 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
	Total (MW)	**600**	**6,136**	**48,132**

(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 10: 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
	Total (MW)	**4,100**	**9,760**	**14,750**

Table 11: 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 12: Summary of Renewable Energy Targets

(i) Renewable Electricity Supply Projection in MW (13% GDP Growth Rate)[1]

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 (installed capacity 2012)	47,490	88,698	315,158
	% of Renewables	23%	10%	18%	20%
	% RE Less LHP	0.8%	1.3%	8%	16%

*From Supply Projections based on 13% GDP growth

[1]CBN, NPC
Short Term: 2013 – 2015; Medium Term: 2016 – 2020; Long Term: 2021 - 2030

(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
Biodiesel (B20)	730	1251	4271

* Based on 13% GDP growth

3.0 THE RENEWABLE ENERGY ACTION PLAN (REAP)

3.1 Introduction

To ensure that the REMP targets outlined are achieved, concrete supportive activities are identified in the short, medium and long term. These activities are organized under the framework programme that makes it supportive to all other programmes.

- Assessment of Resource Base/Data Acquisition
- Renewable Energy Policies, Regulatory and Institutional Frameworks
- Capacity Building and Skill Development Programme
- Public Awareness/Sensitization
- Development of Financing Options Program
- Development of Renewable Projects
- Incentives for Renewable Energy Development
- Research and Development
- Standards, Codes of Practice & Specifications
- Local Manufacturing and Commercialization

The action plan is presented in tabular form featuring: Targeted Outcome, Activity Area, Responsible agencies, Proposed Funding Sources and Time line broken into Short, Medium and Long-term. These activities are grouped into the short-term (2012– 2015), Medium term (2016 – 2020) and Long-term (2021- 2030).

3.2 Component – 1: Assessment of Resource Base/Data Acquisition

The assessment of renewable energy resource is essential for the appropriate design and successful operation of any renewable energy system.

Table 13: Assessment of Resource Base/Data Acquisition

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
Databases for each renewable energy resource established	Conduct comprehensive survey of biomass energy resources by State, type, utilization, potential and uses.	NIMET, ECN, NBS, FMoP, FMA&RD, FMEnv, FMWR	FGN(ECN), OPS, DPs	*	*	*
	Conduct National Solar Radiation Database and Mapping	NIMET, NBS, ECN, FMoP	FGN(ECN), OPS, DPs	*	*	*
	Conduct comprehensive mapping and National Survey and Inventory of all SHP sites by State, River Basins and Local Government	NIMET, NBS, FMST, RCs, RIs, TIs, OPS, DPs	FGN(ECN), OPS, DPs	*	*	*

	Establish Renewable Energy Databank at Federal and State Levels	FMAv, NIMET, FMST, RCs, RIs, TIs, OPS, DPs	FGN(ECN), OPS, DPs	*	*	*
	Review and Update the existing Wind Resource Map - National Wind Energy Information System (Wind Map)	FMAv, NIMET, FMST, RCs, RIs, TIs, OPS, DPs, FMoP	FGN(ECN), OPS, DPs	*	*	*
	Collect, collate and analyze data from existing meteorological stations	FMAv, NIMET, FMST, RCs, RIs, TIs, OPS, DPs, FMA&RD, FMWR, RBDA	FGN(ECN), OPS, DPs	*	*	*
	Establish more meteorological stations	FMAv, NIMET, FMST, RCs, RIs, TIs, OPS, DPs	FGN(ECN), OPS, DPs	*	*	*
	Assess potentials of new and emerging RE resources- hydrogen, ocean tides and geothermal in Nigeria	FMAv, NIMET, FMST, RCs, RIs, TIs, OPS, DPs, FMAv	FGN(ECN), OPS, DPs, NNPC	*	*	*
	Periodic Review and Update of Databases of each RE resource	FMAv, NIMET, FMST, RCs, RIs, TIs, OPS, DPs	FGN(ECN), OPS, DPs		*	*

3.3 Component – 2: Renewable Energy Policies, Regulations and Institutional Frameworks

Clear policies, regulations and institutional frameworks are essential in the attainment of renewable energy programmes. The following are thus, articulated in table 3.2.

Table 14: Renewable Energy Policies, Regulations and Institutional Frameworks

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
RE Policies, Regulations and Institutional Frameworks established	Implementation of RE policies, programs and regulations to support large-scale renewable energy development	FMST, FMEnv, NNRA, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC, FMW&SD	FGN(ECN), OPS, DPs	*	*	*

	Production of Draft Legislation for a Solar Water Heating Obligation in the residential, commercial & institutional sectors	FMST, FMEnv, NNRA, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC, NASS	FGN(ECN), OPS, DPs	*	*	*
	Advocacy to ensure the approval	CBO, NGO, NIPC	FGN (ECN), OPS, DPs	*	*	*
	Strengthening of leadership and implementation capacity at Federal, State and Local governments levels	FMST, FMEnv, MPR, FMWR, NNRA, NNPC, NERC, OPS, DPs	FGN (ECN), OPS, DPs	*	*	*
	Development of mechanisms to mobilize investments through financial and fiscal incentives, improve access to financing (microfinance) and provide targeted subsidies	MPR, DPR, NNPC, OPS, DPs, FMF, BOI, NIPC	FGN (ECN), OPS, DPs, FMF	*	*	*
	Streamline and harmonize all policies on renewable energy for a unified target setting	ECN, MPR, DPR, NNPC, OPS, DPs	FGN (ECN), OPS, DPs	*	*	*
	Enhance coordination of institutions involved in the development of renewable energy, and clearly define the roles of each institution and stakeholder.	FMST, FMEnv, NNRA, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC	FGN(ECN), OPS, DPs	*	*	*
	Pre-determine Feed – In Tariffs for Renewable energy	NERC	NERC	*	*	*
	Conduct the assessment of Standard PPAs and Set up a standard PPAs (Power Purchase Agreements) for electricity from renewables, as well as other incentives	NERC, FMoP	FGN(ECN), OPS, DPs	*	*	*

	Compile directory of all policy instruments on renewable energy in Nigeria	ECN	FGN (ECN)	*	*	*
	Support existing nation-wide and sub-regional networks designed to promote the exchange of policy experiences, model policy case examples and lessons learned in renewables development	FMST, ECN, FMEnv, NNRA, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC	FGN(ECN), OPS, SON	*	*	*
	Quality assurance and standards for the renewables sub-sector	FMST, FMEnv, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC, SON	FGN(ECN), OPS, DPs	*	*	*
	Periodic Review of the Renewable Energy Master Plan	FMST, FMEnv, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC	FGN(ECN), OPS, DPs	*	*	*
Institutional Framework established	Amend ECN law to make ECN National focal point for Renewable Energy and Energy Efficiency	FMST, FMEnv, FMW&SD, FMWR, DPR, MPR, DPs, NNPC, OPS, NGO, NERC, NASS	FGN(ECN), OPS, DPs	*	*	*
	Strengthen existing Renewable Energy Associations	FMST, ECN, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC	FGN(ECN), OPS, DPs	*	*	*
	Promote the establishment of more Renewable Energy Specific professional and industry associations	FMST, FMEnv, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC	FGN(ECN), OPS, DPs	*	*	*

	Coordinate the Renewable Energy Related activities in various Agencies, Ministries and departments	FMST, NIPC, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC	FGN(ECN), OPS, DPs	*	*	*
	Encourage other Federal and State institutions to mainstream renewable energy development into their development efforts – like Ministries of Works, Water Resources, Agriculture, etc…	FMST, FMEnv, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC, NPC	FGN(ECN), OPS, DPs	*	*	*
	Establishment of Renewable Energy Development Agency (REDA)	FMST, FMEnv, NNRA, FMWR, DPR, MPR, DPs, NNPC, OPS, NERC, NGOs	FGN(ECN), OPS, DPs, NGOs			*

3.4 Component – 3: Capacity Building and Skills Development Program

Relevant and adequate human capacity and skills are essential for implementation of renewable energy programmes. Thus, the following are articulated:

Table 15: Capacity Building and Skills Development Program

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
Training Workshops organized	Organise Training and Re-training Workshops on all renewable energy types for Engineers	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMST, RMRDC, MAN, NAPTIN, NGOs	FGN, OPS, DPs, NNPC, PTDF	*	*	*

	Organise Training and Re-training Workshops on all renewable energy types for Technicians and Craftsmen	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMST, RMRDC, MAN, NAPTIN, NGOs	FGN, OPS, DPs, NNPC, PTDF	*	*	*
	Organise Training and Re-training Workshops on all renewable energy types for relevant Ministries, Agencies and Departments at Federal, State and Local Governments	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMST, RMRDC, MAN, NAPTIN, NGOs	FGN, OPS, DPs, NNPC, PTDF	*	*	*
	Capacity and training to improve skills necessary for local design and manufacture of renewable energy technologies	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMST, RMRDC, MAN, NAPTIN, NGOs	FGN, OPS, DPs, NNPC, PTDF	*	*	*
	Organise Training and Re-training Workshops on the Design, Construction and Installations and Maintenance of renewable energy technologies	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMST, RMRDC, MAN, NAPTIN, NGOs	FGN, OPS, DPs, NNPC, PTDF	*	*	*
Renewable Energy Mainstreamed into the Nation's Education Curricula	Organise On-the-Job Training for NYSC	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, FMST, FMYD, NAPEP, NYSC, NDE, NAPTIN	FGN, OPS, DPs	*	*	*

	Organise Advanced Training (Overseas and Local) Courses on specific renewable energy type	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs	FGN, OPS, DPs	*	*	*
	Organise training on the preparation of pre-feasibility and feasibility assessments on viability of renewable projects	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs	FGN, OPS, DPs	*	*	*
	Short Courses and postgraduate programs overseas on various renewable energy sources	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs	FGN, OPS, DPs	*	*	*
	Introduce Renewable Energy into the nation's educational Curriculum	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs	FGN, OPS, DPs	*	*	*
	Developing indigenous human and institutional capacities in the genetic manipulation of fast growing tree species.	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, FMST	FGN, OPS, DPs			
	Conduct periodic national renewable energy manpower survey to determine the actual Re Expert base of the country	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, SGs, LGAs	FGN, OPS, DPs	*	*	*
	Develop and Implement Specialized Renewable Energy Curricula into the nation's higher educational system	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, FMST, NUC, NBTE, NCCE	FGN, OPS, DPs	*	*	*
	Conduct a Study on the Nigeria's Renewable Energy Manpower Stock and Needs	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE	FGN, OPS, DPs	*	*	*

	Develop Curricula for primary, Secondary and Tertiary Institutions on different Renewable Sources	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, FMST, NUC, NBTE, NCCE	FGN, OPS, DPs	*	*	*
	Establishment of Barefoot-College for the training of local artisans and end users on the installation, utilization, maintenance and safety of renewable energy technologies	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, FMST, NAPEP, NDE, FMoD, NBTE	FGN, OPS, DPs	*	*	*
	Establish linkages/collaboration between tertiary institutions, research centres and industries	NNPC, ECN, NBS, FMEd., OPS, PTDF, DPs, NBTE, FMoP, NGOs, BOI, NUC, NBTE, NCCE	FGN, OPS, DPs	*	*	*

3.5 Component – 4: Public Awareness/Sensitization

Even-though the Energy Commission of Nigeria and many other organizations have been organizing several workshops and sensitization programmes on renewable energy, many Nigerians are still ignorance of the benefits of renewable energy and its exploitation. The following are some of the awareness and sensitization activities and projects that should be embarked upon to create greater awareness.

Table 16: Public Awareness/Sensitization

Targeted Outcome	**ACTIVITIES**	**Responsible**	**Proposed Funding Sources**	**TIMELINE**		
				Short Term	**Medium Term**	**Long Term**
RE Awareness Created among Nigerians	Setting up of renewable energy awareness programs (including solar villages in each state)	ECN, NOA, NGOs, CBOs, DPs, OPS, FMST, FMoP, FMoI, RCs, Media	FGN, OPS, DPs	*	*	*
	Organise regular programs on radio and TV to demonstrate the role of renewable energy	FMST, FMoI, Media	FGN, OPS, DPs	*	*	*

	Develop awareness creation & public enlightenment programmes on different renewable energy technologies for the print and electronic media	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, FMST, NESREA, ERCs, Media	FGN, OPS, DPs	*	*	*
	Develop awareness creation & public enlightenment programmes on different renewable energy technologies for primary, secondary schools	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, FMST, FMYD, FMWA, FMoN-D, ERCs, Media	FGN, OPS, DPs	*	*	*
	Develop awareness creation & public enlightenment programmes on different renewable energy technologies for the Federal, State and governments assemblies	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, FMST, ERCs, Media	FGN, OPS, DPs	*	*	*
	Develop awareness creation & public enlightenment programmes on different renewable energy technologies for the Fed. Ministry Officials, Youth & Women groups	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, ERCs, Media	FGN, OPS, DPs	*	*	*
	Publications in print media on renewable energy resources, development and technologies	ECN, FMoI, DPs	FGN, OPS, DPs	*	*	*
	Institute periodic international fairs on specific renewable energy source	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, Judiciary, NASS, SASSs, LGAs, ERCs, Media	FGN, OPS, DPs	*	*	*

	Organize Awareness and Sensitization Seminars for Law and Policy makers	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, ERCs, Media	FGN, OPS, DPs	*	*	*
	Organise Annual Renewable Energy Week	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, Energy Research Centres, Media	FGN, OPS, DPs	*	*	*
	Organize Community based information and communications technology dissemination training for NYSC	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, ERCs, Media	FGN, OPS, DPs	*	*	*
	Organise Advanced Training (Overseas and Local) Courses on specific renewable energy type	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, PTDF, ERCs, Media	FGN, OPS, DPs, PTDF	*	*	*
	Production of handbills, leaflets, postcards, calenders, jingles and documentaries on renewable energy technologies	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, ICRC, FMST, Nollywood, ERCs, Media	FGN, OPS, DPs	*	*	*
	Build up partnerships between government, private sector and civil society for renewable energy development.	ECN, NOA, NGOs, CBOs, DPs, OPS, FMoP, FMoI, FMT&I, ERCs, Media	FGN, OPS, DPs	*	*	*

3.6 Component – 5: Development of Financing Options Program

Renewable energy ventures often have high up-front cost, and many projects require government support in the initial start-up phases. Access to affordable finance is a major constraint. Traditional banks are often unwilling to finance renewable energy projects due to market uncertainties and perceived high risks, such as, high initial capital costs on a per kW basis; higher transaction costs in the case of smaller renewables; uncertainty of the resource base; limited number of developers with the skills to prepare financing packages that meet the requirements of financial institutions; price uncertainty in the

market for final renewable energy service; and, lack of off-takers for renewable energy produced. In some cases, there are limited data and information on the renewable energy industry to guide investors and financiers in making sound judgments and decisions in renewable energy projects development.

The activities in this component is geared towards increasing availability of information on renewable energy project investments, and enhancing collaboration between the various stakeholders, to ensure successful renewable energy project investments. Financing for RETs can be in the form of assets, venture capital, private equity, loans and grants, or multiple combinations of these.

The key question that needs to be addressed is: what are the options and strategies for mobilizing domestic and international capital to finance the investment requirements of sustaining long term energy and socio-economic development in Nigeria?

In the light of the above question, some measures need to be put in place in addressing the key issues. For instance, energy projects should be properly chosen, designed and packaged to be attractive to domestic and foreign investors. Moreover maximum advantage should be taken of the international funds available for environmentally sound energy projects.

In Nigeria access to energy finance is affected by:

- Inadequate national support system that guarantees the attraction and security of investment,
- Inadequate financial capacity for energy investment
- Slow judicial process in settling dispute
- Inadequate strategies for attracting offshore financing
- Political and regulatory risks for investment in energy infrastructure
- Inadequate incentives to business to invest in new technologies

Some of the remedial measures to counter these, especially for the energy sector, have been enumerated in this REAP such as establishing a tax holiday scheme, Introducing tariffs that guarantee good rate of return on investment etc. Moreover some of the identified niche products that could be employed in financing energy projects are Equity financing mechanism, bond market, financial collaboration between government/private with bilateral and multilateral institutions etc.

Table 17: Development of Financing Options Program

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
Enabling environment for private sector investments for Renewable Energy development created	Assist institutions and project developers in financial analysis of renewables investment	REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMEnv)	*	*	*
	Producing draft legislation for a Fossil Fuel Levy Act to finance Renewable Energy development projects in the country	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC, NIPC, BOI	FGN (FMEnv)	*	*	*
	Establish Renewable Energy Development Fund	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMEnv)	*	*	*
	Provide fiscal incentives: suspension of import duties, tax holiday, investment grants, operational grants, etc..	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC, NIPC	FGN (FMEnv)	*	*	*
	Partner with financial institutions to develop financing options for renewables	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC, BOI	FGN (FMEnv)	*	*	*
	Develop a portfolio of renewable investment projects which can be developed as pilot projects	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)	*	*	*

	Support training on renewables project development targeted at accessing carbon finance	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)	*	*	*
	Develop pipeline of projects that can access carbon financing	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)	*	*	*
	Introducing tariffs that guarantee good rate of return on investment (E.G, Feed- In – Tariff, etc..)	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)	*	*	*
	Instituting a scheme for accelerated depreciation of equipment in respect of (foreign) loans invested in energy projects.	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)			
	Establishing special risk fund scheme for commercialization of new and emerging energy technologies such as RET	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)	*	*	*
	Attracting long-term financing from international institutions	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)			
	Providing adequate security for energy infrastructural facilities	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)			

	Ensuring the provision of basic physical infrastructural facilities to enterprises involved in the development of the energy sector.	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC	FGN (FMF)			
	Introducing environmental regulations that encourage investment in environmental friendly technologies	NERC, REA, FMF, OPS, DPs, FMST, ECN, MSMD, FMJ NASS, MPR, DPR, NNPC, NESREA	FGN (FMF)			

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, 1st June 2012 – 31st May 2017

3.7 Component – 6: Development of RE Projects

Nigeria is well endowed with a wide range of renewable energy resources, including hydro-electricity, biomass, solar, wind, and other renewables, most of which are currently under-exploited. Based on experience from various initiatives that have been undertaken to date, the use of these renewable energy resources could contribute significantly to the development of the energy sector in many African countries.

If successfully exploited, renewables can significantly contribute to addressing two key challenges facing the energy sector in Nigeria: **Energy Access**: Increasing access to modern energy for the wider majority in pursuit of poverty reduction, MDGs, and more equitable socio-economic development; **Energy Security**: Responding to the increased burden of the high cost of fossil fuels compounded by power shortages triggered by lower investment flows to the power sector and drought.

Renewables can contribute to poverty alleviation and assist in addressing the Millennium Development Goals (MDGs), by providing modern improved energy services to the poor. Renewables are particularly suited to meet the decentralized energy needs of poor rural remote community institutions such as hospitals, dispensaries, schools, and farmer training centers. This is particularly true of small-scale renewables that are made locally and run on locally available resources. Such systems can provide energy that is both affordable and a source of employment and enterprise creation for both the rural and urban poor. Examples of such renewables include:

- Low cost more efficient biomass-based combustion technologies (e.g., improved cook stoves, efficient charcoal kilns, brick making kilns, fish smokers, tea dryers, and wood dryers);
- Pico and micro hydro for shaft power for processing agricultural produce and increasing its value, as well as for pumping water;
- Low cost efficient hand tools and animal drawn implements, to increase the agricultural productivity of rural areas;
- Treadle, wind, and ram pumps for irrigation to increase agricultural outputs and generate income for the farmer;
- Solar dryers that lower post-harvest losses enabling farmers to market their produce when prices are higher;
- Solar water purifiers to provide clean potable water and reduce water borne diseases, which translates to increased availability of labor and thus increases agricultural output and income.

Renewables offer diversification in energy generation and therefore can play a vital role in increasing energy security by minimizing risks related to high and unstable oil prices. Some renewables are not reliant on rainfall (e.g., geothermal, solar, wind) thereby reducing climate variability related risks.

In fact, it could be argued that in view of the continued and serious lack of access to energy in Nigeria and the increased energy security challenges, policy makers in the country now fully recognize the need to develop renewable energy as a matter of priority.

The widespread deployment of renewables in the region has also been constrained by other factors that include: poor institutional frameworks and infrastructure; inadequate planning; the lack of coordination and linkage in national renewables programs; pricing distortions that place renewable energy at a disadvantage; high initial capital costs; weak dissemination strategies; lack of skilled manpower; poor baseline information; and low maintenance capacity. Therefore, meaningful scaling up of the use of renewable energy resources can only be realized if these barriers are overcome through specific projects and programmes as outlined as follows:

Table 18: Development of RE Projects

Targeted Outcome	**Activities**	**Responsible**	**Proposed Funding Sources**	**Timeline**		
				Short Term	**Medium Term**	**Long Term**
Biomass Projects established	Identifying the fast growing indigenous trees species.	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMST, FIRN	FGN, OPS, DPs, NNPC, PTDF	*	*	*
	Identifying & sourcing foreign fast growing tree species	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Creating nurseries and intensifying the cultivation of plantation of fast growing trees	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Establishing more shelter belts in the semi-arid zones	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Establishment of Small-Scale Industries for the design and production of improved woodstoves	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, SMEDAN, FMST, RMRDC, NDE, NARICT NCAM	FGN, OPS, DPs	*	*	*

	Construction of biodigester plants	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST, FMT&I, RMRDC, NDE, NARICT, NCAM	FGN, OPS, DPs	*	*	*
	Establishment of bio-fuels plants	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMT&I	FGN, OPS, DPs	*	*	*
	Establishment of energy farms	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Manufacture and dissemination of improved woodstoves	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Establishment of briquetting plants for fine particle of biomass	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
Blending of up to 10% of fuel ethanol with gasoline (E-10)	Develop local capacity for large scale production of biofuels feedstock	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Establishment of plantations of energy crops and biofuels plants	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*

	Creating Market Demand for Biofuels	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMF, DPR, NIPC, FMT&I	FGN, OPS, DPs	*	*	*
	Registration of Biofuels Plants	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMF, DPR, NIPC, FMT&I	FGN, OPS, DPs			
	Provide fiscal and economic incentives: Tax holiday, waiving VAT, etc…	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMF, DPR, NIPC, FMT&I	FGN, OPS, DPs	*	*	*
	Development of the Biofuels Industry Equity Fund	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMF, BOI, FMT&I	FGN, OPS, DPs	*	*	*
Solar Energy Projects	Construction of Solar Projects in the residential, commercial and industrial setors	ECN, NGOs, FMEnv., SGs, LGAs, OPS, DPs, FMST, FMT&I, RMRDC, NARICT	FGN, OPS, DPs	*	*	*
	Construction of Solar Thermal Projects in the residential, commercial and industrial setors	ECN, NGOs, FMEnv., SGs, LGAs, OPS, DPs, FMST, FMT&I, RMRDC, NARICT	FGN, OPS, DPs	*	*	*
	Develop and site appropriate solar schemes	ECN, NGOs, FMEnv., SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*

	Installation of Solar Home Systems	ECN, NGOs, FMA&WR, FMEnv., SGs, LGAs, OPS, DPs, FMH&UD	FGN, OPS, DPs	*	*	*
	Installation of Solar Water Pumping	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*
	Installation of Solar Street and traffic Lightings	ECN, NGOs, FMEnv., SGs, LGAs, OPS, DPs, FMH&UD	FGN, OPS, DPs	*	*	*
	Construction of Large-Scale Solar PV plants	ECN, NGOs, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*
	Installation of Solar projects for community services	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Installation of Solar Collectors	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Installation of Solar Cookers	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Installation of Solar Dryers, Chicken Brooders, etc…	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Installation of Solar desalination, solar stills, etc..	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Installation of Solar efrigeration and A/C	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*

	Installation of Solar thermal electricity	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Installation of Solar pasteurization, sterilization	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs	FGN, OPS, DPs	*	*	*
Small Hydro Projects	Construction of Small Hydropower Stations in each of the six geopolitical zones of the country	FMWR, FMP, FMEnv, ECN, OPS, DPs	FGN, OPS, DPs	*	*	*
	Refurbishment of abandoned SHP projects in the country, namely: - 6 MW Hydro project	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP	FGN, OPS, DPs	*	*	*
	Progressively increasing indigenous participation in the planning, design and construction of hydropower plants in a ratio that ensures full benefits to the country	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP	FGN, OPS, DPs	*	*	*
	Promote local manufacturing & fabrication of turbines and other electro-mechanical compnents	NNPC, ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP	FGN, OPS, DPs	*	*	*
Wind Energy Projects	Installation of Wind Power Plant	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*
	Carry out feasibility study for a hybrid demonstration plants	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*

	Construction of Wind-Solar-Hydro hybrid plants	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*
	Establishment of Wind Technology Centre	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST, NUC, NBTE, NCCE, ERCs	FGN, OPS, DPs	*	*	*
	Construction of Wind Projects in the residential, commercial and industrial setors	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST, NUC, NBTE, NCCE, ERCs	FGN, OPS, DPs	*	*	*
	Develop and site appropriate wind schemes	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*
	Installation of wind Home Systems	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST, FMH&UD	FGN, OPS, DPs	*	*	*
	Installation of Wind Water Pumping	ECN, NGOs, FMA&WR, FMEnv.,SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*
	Construction of Large-Scale wind power plants	ECN, NGOs, FMEnv., SGs, LGAs, OPS, DPs, FMoP, FMST	FGN, OPS, DPs	*	*	*

	Encouraging local and foreign investors to establish factories for production of major components of wind energy systems (e.g. wind turbines, blades, deep cycle batteries, charge controllers	ECN, NGOs, FMEnv., SGs, LGAs, OPS, DPs, FMoP, FMST, FMF, FMFA, NIPC, FMT&I	FGN, OPS, DPs	*	*	*

3.8 Component – 7: Incentives for RE Development

Governments should pursue investment incentives for the exploitation of renewable energy as a means to an end. Policy-makers attribute poor renewable energy development in most countries to a lack of investment. Incentives are used as a tool to boost investment and growth, even if the causal links between each of these stages is far from proven. Incentives work by changing the parameters of an investment project. Investors choose to make investments when the Net Present Value (NPV) of a project's cash flows (suitably discounted) is greater than zero. In a world where companies face capital rationing, they choose the mix of projects with the greatest Internal Rate of Return. Incentives bias investors' decision-making positively in favour of investments in certain sectors like renewables. By reducing the tax burden or providing cash incentives, there is increased expected profitability of projects in those sectors. Where investors have good access to finance, the introduction of special incentives to certain sectors should in theory lead to an overall increase in investment.

Experiences have shown that government policy support is the key to moving commercial renewable energy development forward in its initial stages. Government-supported financial and economic incentives, in particular, play an important role in helping to develop commercial markets and reduce the financial life-cycle costs of renewable energy technologies.

The governments also recognize that the financial life-cycle costs of today's renewable energy systems often exceed those of conventional alternatives. As a result, governments are providing financial incentives to help overcome the financial incremental costs of renewable energy systems. In most cases, the financial incentives are structured and applied in ways that aim to reduce the cost of renewable energy systems, thereby building toward a future where the technologies are financially viable. Financial incentives are also being provided to counterbalance those provided to conventional alternatives (that is, to provide a level playing field), and to account for environmental costs and benefits not considered in conventional economic comparisons and pricing methodologies.

Table 19: Incentives for RE Development

Targeted Outcome	ACTIVITIES	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
ECONOMIC INCENTIVES	*Provision of low interest soft loans* from special low interest development finance agencies such as Bank of Industry (BOI) and Community Bank should be reserved for Renewable Energy Supply and Utilization Projects, at interest rate not exceeding 5% p.a.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Subsidies and Grants: Subsidies of up to 30% of initial costs of a RE utilization facility is to 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.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Waiver of Purchase Taxes: Individual, corporate or community consumers of RE technologies should benefit from a waiver of initial purchase taxes, such as VAT.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*

	Provision of appropriate rebates on income Taxes and Levies for individuals and corporate bodies who acquire, at their own cost, renewable energy technologies and who are subject to income tax or community levies by government	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*
FISCAL INCENTIVES	**Lower Profit Tax:** Corporate organizations that are involved in RE business should pay profit tax at 50% of prevailing rate (presently 30%).	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Tax Holidays: For new companies active in RE, a tax holiday should be provided for a minimum of ten years of operation.	CBN, FMF, NCs, OPS, DPs, NIPC, FIRS	FGN, OPS, DPs	*	*	*
	Reduction in Import Duty for materials, components and equipment used for the manufacturing of RE devices, products and components.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Capital Allowance: Investment Capital Allowance of 20% per year for the first four (4 No.) years and 19% in the 5th year, with 1% retained in the books, is to be provided.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*

	Capital Relief: Government should provide interest free capital relief of 50% on the initial investments to genuine manufacturers of renewable energy 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 1st, 2nd, 3rd and 4th repayment years respectively, beginning from the second year of production, is to be specified.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*
	Encourage the use of Solar water heaters and biogas for water heating in new housing estates, as well as bio-fuels in transport vehicles.	CBN, FMF, NCs, OPS, DPs	FGN, OPS, DPs	*	*	*

3.9 Component – 8: Research and Development

Coherent R&D programmes for renewable energies are key elements in designing political strategies, not only for renewable energies but also for climate mitigation. Enhancing the dialogue between science and policy is essential to achieve a consistent global approach which takes into account the maturity of the different renewable energy technologies.

Renewable energy could meet almost half of global energy demand by 2050 according to the International Energy Agency's ambitious BLUE MAP scenario published in Energy Technology Perspectives 2008.

Research and development (R&D) has a vital role to play if the potential of renewable energy is to be fully exploited. Policy measures, such as taxes, cap and trade schemes, obligations and feed-in tariffs, which take into account environmental impacts and, in particular, the social cost of carbon dioxide emissions, will contribute to faster deployment. However, investment in R&D will not be delivered by market signals alone;

extensive support at the national and international levels is needed to accelerate the development of renewable technologies.

R&D targeted at different stages of the innovation chain will yield benefits in the short-term (up to five years), medium-term (5–15 years); and in the longer term (15 years plus). R&D with a short-term focus is needed to improve technologies that are already technically proven like: small hydro, wind energy and the standard silicon-based conversion of solar energy to electricity in photovoltaic (PV) cells.

Much R&D with a short-term perspective will be provided by industry itself. But research activity in publicly-funded institutions (universities, laboratories and institutes) will also be needed. This will provide basic scientific insights and respond to the more fundamental science, engineering and socio-economic challenges that are inevitably thrown up in the process of demonstrating and deploying new technologies.

R&D with a medium and long-term perspective is needed to underpin long-term improvements in renewable technologies and enable breakthroughs that could give such technologies a decisive advantage in energy markets. The medium-term goal must be to ensure that renewables can compete successfully, without subsidy, once external environmental costs and other contributions to social goals (e.g. access, security) are taken into account. Medium- or long-term R&D efforts in this area will largely be developed through public sector support.

Regardless of whether R&D is conducted with a long or short-term perspective, it must contribute to improved performance and cost reductions or otherwise help to reinforce the role of renewable energy in a sustainable energy system. Areas of focus for R&D activity should be:

- improved performance, including conversion efficiency, reliability, durability and sustainability;
- advanced manufacturing techniques for components;
- reduced material requirements, especially for toxic materials;
- sustainable production processes that minimize life-cycle environmental impacts through manufacturing, use, recycling and final disposal;
- improved methods for integrating renewable energy into buildings, electricity grids and other distribution systems;
- socio-economic research aimed at developing effective policy measures that will encourage the deployment of renewables and enhance public acceptability of new energy technologies; and
- capacity-building aimed at developing new generations of trained scientists, engineers and others.

Table 20: Research and Development

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
RE National Programmes developed and Research Centres well-equiped	Intensify R & D in renewable energy science and technology as well as policy analysis and market research	FMST, ECN, RIs, OPS, DPs, TIs.	FGN (ECN), OPS, DPs	*	*	*
	Provide increased funding to research institutes, centers and tertiary institutions, who are undertaking R & D work on renewable energy resources to ensure production and industrial applications.	FMST, ECN, RIs, OPS, DPs, NASENI	FGN (ECN), OPS, DPs	*	*	*
	Upgrade facilities in the nation's designated renewable energy research centres and institutes.	FMST, ECN, RIs, OPS, DPs	FGN (ECN), OPS, DPs	*	*	*
	Equip the National Renewable Energy Centres and other Universities with energy R & D capability and facilities	FMST, ECN, RIs, OPS, DPs, Tert. Insts.	FGN (ECN), OPS, DPs	*	*	*
	Conduct R & D and technical studies on renewable energy policies and institutional structures as well as for detailed case study assessments	FMST, ECN, RIs, OPS, DPs, Tert. Insts.	FGN (ECN), OPS, DPs	*	*	*

	Develop and promote local capability in the nation's Energy Centres and Research Institutes for the design and fabrication of efficient (environmentally friendly) energy devices and technologies for the utilization of renewable energy resources	FMST, ECN, RIs, OPS, DPs, NASENI, NESRESA, NDE, RMRDC	FGN (ECN), OPS, DPs	*	*	*
	Ensure that earnings from crude oil and other energy resources contribute significantly to Research, Development and Training (R, D & T) in renewable energy sub-sector of the national economy.	FMST, ECN, RIs, OPS, DPs, MPR, NNPC, PTDF	FGN (ECN), OPS, DPs	*	*	*
	Develop research portfolios in solar thermal energy & solar PV, Wind, Small Hydo and Biomass	FMST, ECN, RIs, OPS, DPs, NASENI, FMoP, REA, TIs	FGN (ECN), OPS, DPs	*	*	*

3.10 Component – 9: Standards, Codes of Practice and Specifications

Interest in the use of alternative energy in the form of renewable energy has increased substantially because of the potential to provide increased reliability and lower cost of power delivery to the customer, particularly with customer-site generation. There are also substantial environmental benefits in reduced or no emissions as compared with traditional technologies.

The new means for generation, storage and transmission of energy present exciting possibilities but raise many questions about safety and reliability, questions that must be answered to ensure public acceptance. For example, the integration of new generation and storage technologies with existing national grids need to provide safe and reliable service during peak and off peak demand.

Governments must be committed to the advancement of safe, renewable and sustainable energy through the necessary research, testing and development of standards and codes to help energy end-users make a smooth and safe transition to alternative energy.

The equipment and systems used for alternative energy are required to comply with numerous electrical, fire, mechanical, plumbing, and building-related codes and

installation requirements. These different codes require compliance with different standards and installation requirements.

Relevant agencies of government have developed standards and codes for use by code and inspection authorities, electric utilities, contractors, installers, users, system designers, and other interested parties to aid in understanding the basic components of alternative energy systems and the applicable codes and standards in order to facilitate a reasonably safe and code-compliant installation.

Table 21: Standards, Codes of Practice and Specifications

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
Standards and Codes for Renewable Energy Technologies established	Compile directory of global and Africa-wide and proven successful standards, codes of practice on renewable energy technologies	SON, ECN, FMJ, FMI&C, NGOs, CPC, Prof. Assocs.	FGN (SON), OPS, DPs	*	*	*
	Develop Standards and Codes for each Renewable Energy Technologies: Installations, Maintenance, Components, etc..	SON, ECN, FMJ, FMoI, NASENI, RIs, NESREA	FGN (SON), OPS, DPs	*	*	*
	Develop standards for solar radiation measurement process, measurement instrument calibration, etc..	SON, ECN, FMJ, FMoI, NIMET	FGN (SON), OPS, DPs	*	*	*
	Develop Standards for solar cells (modules) characteristic measurement, solar cells (modules) tests and other standards referring to solar cells (modules) production and testing, etc.	SON, ECN, FMJ, FMoI, Ris, NESREA	FGN (SON), OPS, DPs	*	*	*
	Develop standards to regulate solar simulators and testing methods.	SON, ECN, FMJ, FMoI,	FGN (SON), OPS, DPs	*	*	*

	In this category various standards regulating modes of photovoltaic system functioning supervision or standards advising planning and implementation of such systems can be found. The category includes safety regulations, which have to be considered upon photovoltaic systems implementation.	SON, ECN, FMJ, FMoI, NESREA	FGN (SON), OPS, DPs	*	*	*
	Develop standards for batteries, over-voltage protection components and other system components not included in the categories mentioned above.	SON, ECN, FMJ, FMoI, NESREA	FGN (SON), OPS, DPs	*	*	*

3.11 Component – 10: Local Manufacturing & Commercialization

Issues of environment, energy security and least-cost energy access for rural populations have all played a role in making renewable energy an integral component of the nation's development strategy. Efforts to promote renewable energy in Nigeria have intensified in recent years, with several domestically and internationally supported initiatives, but the widespread commercialization and adoption of locally manufactured technologies are impeded by many challenges in capacity, financing, policy, technology and information. This component is meant to strategically address a number of these challenges.

Table 22: Local Manufacturing & Commercialization

Targeted Outcome	Activities	Responsible	Proposed Funding Sources	Timeline		
				Short Term	Medium Term	Long Term
	Establish National Renewable Energy Technologies Designers Association (NRETDA)	BoI, FMoI, OPS, DPs, ECN, SON, MAN, FMST	FG (ECN)	*	*	*
	Conduct Inventory of Locally manufactured renewable appliances and equipment in Nigeria	BoI, FMI &C, OPS, DPs, ECN, SON, MAN, FMST, RMRDC	FG (ECN)	*	*	*

	Produce catalogue of existing Energy R & D results and pilot projects in the country	BoI, FMoI, OPS, DPs, ECN, SON, MAN, FMST, RMRDC, NBS	FG (ECN)	*	*	*
	Link industrial Sector to Energy R & D agencies/institutions and vice versa	BoI, FMoI, OPS, DPs, ECN, SON, MAN, FMST, NASENI	FG (ECN)	*	*	*
	Develop comprehensive database of researchers, profiling their work and expertise	BoI, FMoI, OPS, DPs, ECN, SON, MAN, FMST	FG (ECN)	*	*	*
	Organize Expos, Trade Fairs to showcase R & D outputs	BoI, FMoI, OPS, DPs, ECN, SON, MAN, FMST, NACCIMA, NIPC	FG (ECN)	*	*	*
	Establish State –of –the art workshop for the manufacturing of simple (environmentally friendly) renewable energy devices	BoI, FMoI, OPS, DPs, ECN, SON, MAN, FMST, NASENI, NIPC	FG (ECN)	*	*	*
	Provide soft loans to project developers to scale up and commercialize pilot projects	BoI, FMI &C, OPS, DPs, ECN, MAN, FMST, NDE	FG (ECN)	*	*	*
	Establish market-based instruments for RE commercialization: concessionary financing arrangements, targeted, but market value credit lines, tax relief to investors and standardized Power Purchase Agreement (PPA), etc..	BoI, FMoI, OPS, DPs, ECN, MAN, FMST, FMF, NIPC	FG (ECN)	*	*	*
	Produce comprehensive business plan for the commercialization of the R & D results	BoI, FMoI, OPS, DPs, ECN, MAN, FMST	FG (ECN)	*	*	*

4.0 ECONOMIC AND FISCAL INCENTIVES

4.1 Introduction

Incentives are essential in promoting the development of renewable energy. 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 Supply and Utilization Projects, at interest rate not exceeding 5% p.a.

(b) Subsidies and Grants

Subsidies of up to 30% of initial costs of a RE 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 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 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 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 business should pay profit tax at 50% of prevailing rate (presently 30%).

(b) Tax Holidays

For new companies active in RE, 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 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.

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

(d) Capital Allowance

Investment Capital Allowance of 20% per year for the first four (4 No.) years and 19% in the 5th 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 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 1st, 2nd, 3rd and 4th 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 components. The stipulated repayment schedule is 20% - 1st year, 30% - 2nd year, 40% -3rd 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 in Government building.

(g) Waiver of Purchase Taxes

Individual, Corporate or Community consumers of renewable energy 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 technologies and who are subject to income tax or community levies by government, such taxes or levies should be subject to rebate as follows:

Expenditure on Renewable Energy Technology	**% Rebate on Tax/Levy**
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 technology.

5.0 RISK IDENTIFICATION AND ANALYSIS

5.1 Introduction

Several factors will militate against the successful implementation of planned activities and milestones, and may hinder the realization of the objectives and targets of the REMP. These potential risk factors include policy and political changes, uncertainties in the energy market, instability in the macroeconomic framework, international shocks, operational risk (inadequate public awareness, human resources and raw materials availability) and risks associated with neglect of infrastructure.

Identification and analysis of these risks will allow stakeholders in the renewable energy economy to factor in these risks, or seek alternative approaches to reaching national renewable energy targets and objectives.

5.2 Policy and Political Risks

Several policy and political risks confront the renewable energy sector. These include:

- *Outlined policies not adopted.* Sound policies elaborately developed by government might at the end of the day not be adopted, and when adopted may not be implemented to significant levels. Several policy documents, including Vision 2010, several Rolling Plans and the recent NEEDS and SEEDS documents have reserved key roles for renewable energy. Such policy attention may not necessarily translate into tangible changes in actions of government. Strategies in addressing such implementation risks include the setting of realistic targets, identification of make-or-break implementation issues, outlining concrete activities to address risks and proactively securing the political will to reach agreed targets.

  The contents of this REMP shall be strengthened by the time the NASS passes the RE bill now before it.

- *Policy inconsistency, instability and contending interests within Government.* A certain risk will prevail when elements of the REMP are not properly aligned to the overall economic policy thrust of the government or are at cross-purposes to some broader energy policy objectives. This may result in policy inconsistencies and poor performance of the Master Plan. Inconsistencies may also result with frequent changes in policy thrusts, for instance in trade policies. Other inconsistent government policies, particularly in the application of tariffs and exemptions, transaction costs at ports, customs clearance procedures, and the use of import bans on goods, merchandize, products, equipment and production machinery; tariff and non-tariff barriers pose great risk on investment in RE.

  When government is irresolute as a result of poor planning or pressure from contending interests, the overall objectives of the Master Plan may be compromised. To address these risks, it is not enough to design rational and

ambitious plans, meeting the concerns and interests of all relevant stakeholders is important in reducing potential conflicts and inertia. Greater chances of success will be achieved when key stakeholders participate fully, and where implementation agencies are properly equipped.

- *Risks of inadequate implementation*. A certain degree of policy short sightedness characterizes the implementation of policies of the country. Even when energy policy documents encourage long term planning, few concrete actions are taken to build the groundwork for meeting future security, economic, social and environmental challenges. The large revenue from finite hydrocarbons and abundance of conventional energy resources may not allow us to see the future challenges of a growing population and declining resource base. Accelerated energy policy reforms where pricing increasingly reflect the opportunity cost of resource use will stimulate conservation and a price regime that encourages investments in renewables.

- *Lack of continuity in government policies.* Government has embarked on several reforms leading to increased liberalization of the energy market, and potentially creating opportunities for renewable energy to make increased market entry. Uncertainties loom over the policy direction of the government that will succeed the present one. In an atmosphere where continuity of policy is often lacking, the risk of a new government discarding prevailing reforms is real. Accelerating the pace of implementation of the REMP and rapidly institutionalizing its activities will assist in entrenching the key activities and achieving its objectives.

- *Socio-cultural conflicts*. Local conflicts and trade disputes often interrupt supply of some RE resources and end products. Restive youths and armed bandits, long-drawn trade disputes, electoral malpractices and endless election petitions – all create a political atmosphere that is not supportive of investments, including potential renewable energy businesses.

5.3 Market Risks

Price distortions, poor regulatory environment and inadequate infrastructure characterize current energy market conditions in the country. This has reduced the scope for competition, growth and innovation in the market. Such market conditions create a disincentive for market entry for mature RE technologies such as solar photovoltaic, small scale hydro and wind power; and make hydrogen, ocean and geothermal energy systems prohibitive.

The energy market in Nigeria is on the verge of vital reforms. These include the Power Sector Reform, solid minerals, oil and gas and specific initiatives on renewable energy. The outcome of these emerging RE options will introduce a more vibrant energy market that will stimulate growth, build infrastructure, increase competition and create a basis for investments in tomorrow's energy systems. The innovations that will follow will reduce market constraints for RE systems. The innovations that will follow will reduce market constraints for RE systems.

However, growing the renewable energy sector will depend on a stable macroeconomic framework. Already the Vision20:2020 outlined a number of risks that are inherent in the Nigerian economy, and they include:

- poor and decaying infrastructure;
- epileptic power supply;
- weak fiscal and monetary policy coordination;
- fiscal dominance;
- pervasive rent seeking behaviour by private and public agents, including corruption;
- weak institution and regulatory deficit;
- policy reversals and lack of follow through;
- inordinate dependence on the oil sector for government revenue/expenditure;
- disconnect between the financial sector and the real sector;
- exchange rate instability;
- insecurity of lives and property.

These factors constrain the development of more rational and liberal macroeconomic framework that is supportive of market development for renewable energy. The following specific factors constitute major risks for the success of the REMP:

- *Weak purchasing power*. The level of poverty in Nigeria is high, and increasing. This reduces opportunities to embark on fuel switching from traditional to modern renewable uses. Certain renewable technologies are comparatively expensive. Even low cost improved woodstoves seem increasingly beyond the affordability of the extreme poor that make up about 70 percent of the population. The risk of increasing poverty will therefore compromise the objectives of the REMP. The situation may change if current reforms in years to come begin to reduce poverty, and when middle class preferences change to greener energy options. Increased emphasis on the provision of micro finance will also assist in boosting the ability of the poor to afford new and cleaner energy options.

- *Inadequate access to investment capital*. There is a major shortage of investment capital, leading to high interest rates for RE electricity. Several promising projects, especially in new areas like renewable energy investments suffer setbacks due to the scarcity of funds from banks and financial institutions. The reforms in the financial sector aimed at creating more solid financial institutions and also warehousing some of Nigeria's current external reserves will help bolster the financial market and improve overall access and cost of credits.

- *High initial cost for electricity generation.* Though conventional energy prices are assumed to hold back the development of alternative energy supplies, the fact of the matter is that the RE systems for electricity generation are more expensive at the initial investment. However in the long run, the capital investment is cheaper than the conventional sources.

- *Poor infrastructure.* Poor infrastructure increases transaction costs and reduces the profitability of businesses. Roads, telecommunication – and in fact, access to energy is important for local manufacturing of renewable energy systems and components.

- *Macroeconomic factors.* Changes in the Nigeria economy or effects from the global economy can result in significantly unstable conditions for the Nigerian currency. The generally upward movement of the exchange rate of the Naira to all international currencies, high interest rate, unfriendly tax regime and excise duty and other levies are great risk to local manufacturing industry.

- *Non-implementation of financial incentives*. The REMP's vision is premised on the immediate imperative to make the playing field among competing energy sources more even. It also envisages a rapid increase in financial incentives to support the growth and development of renewable energy in Nigeria. However, there is always a risk that the implementation of these agreed incentives might fall short of the requirements of the sector. Non- implementation or withdrawal of government incentives such as subsidies would result in low return on investment, which could ultimately lead to project abandonment.

- *Loan defaulting.* Unfortunately, Nigeria has not been able to develop the culture of prompt loan repayment as many other African countries especially in southern and eastern sub-regions have successfully done. This is a great threat and risk to renewable energy market development, as loans would necessarily have to be repaid in order to sustain and expand the market. The fund managers also are a great risk to the market as examples of failed banks and national project funds that have been mismanaged are many. The poor state of public utilities is a glaring example of their reluctance to pay bills. Utility's unintelligible tariff and billing have to be avoided in the new renewable energy market.

- *Counterpart funding.* Projects requiring counterpart funding have often been delayed because of the inability of the country to meet its own obligation. Investing in realistic projects and increased political will to back them up is essential.

5.4 International Development Risks

In an increasingly interdependent world, globalization in the movement of capital, technology, goods and services transcend boundaries and subject plans like the REMP to pressure. Of particular importance to the success of the REMP is the global market for renewable energy technologies and the actions of other governments and international agencies. However, the following global risks may affect RE development in Nigeria:

- *Global market risks*. Several international developments with strong impacts on the successful implementation of the REMP are outside Nigeria's control. For

instance, while the objectives of the REMP are premised on lowering the cost of renewable energy technologies, such as PVs, phenomenal growth in demand from developed countries, primarily USA and Germany, have kept the price of solar modules at a high level. Local incentives in other countries can both influence the prices of our renewable import, and will also determine the appetite of major manufacturers of these technologies to venture into our markets.

- *International cooperation risks*. Multi-lateral agencies such as the World Bank, UNDP, ADB as well as bilateral agencies such as USAID have contributed greatly to lifting renewable energy from relative obscurity to the mainstream of energy policy making. Much of the planned activities of the REMP are expected to be financed from international sources. This constitutes a major risk factor that must be managed to prevent the crumbling of the main pillars of the REMP. Managing other related issues such as democracy, economic reforms and good governance is important in securing international support for clean and renewable energy programmes.

5.5 Standards and Quality Control Risks

A major constraint to the development of the renewable energy market in Nigeria is the inadequate implementation of established standard and quality control of locally manufactured and imported technologies. Creating quality assurance is a precondition for building consumer confidence and in growing the market for renewable energy. Three important dimensions to issues of quality include the perception potential users, quality assurance as well as professionalism among operators.

- *Perception* on *untested technologies*. Much of the technologies envisaged in the REMP are "new", or non-conventional. This is so much the case for improved fuelwood burning stoves as they are for biogas plants or solar water heaters. Potential users are worried about their efficacy or complexities in using them. The perception of most of these systems are untested technologies can only be countered by increased public awareness and policy reform that makes them more affordable.

- *Poorly developed standards and testing procedures.* Presently, there are inadequate number testing centers for both locally made and imported renewable energy technologies. Consequently the requisite regulatory environment does not exist. This results to sub-standard technologies that harm the market. The REMP recommends the strengthening of agencies responsible for quality control and standards for product entering the Nigerian market with emphasis on RE technologies.

- *Entry of unqualified people in the field*. The lack of professional associations and strong entrepreneurship in emerging renewable energy businesses, particularly solar PV and improved woodstoves result in people without the relevant professional background to enter the industry. They achieve bad publicity for the industry and make market growth difficult.

5.6 Research and Development Risks

A vibrant R&D capacity and infrastructure is crucial in achieving several objectives of the REMP. Building the capacities to launch and sustain programmes are major concerns.

- *R&D capacity risk.* Achieving the targets of the RE will depend on the identification of appropriate resource centres and professionals to lead the long term R&D programmes. The conditions of Nigeria's R&D institutions fall short of expectations in several respects, including funding, infrastructure, professional morale, etc. Poor economic conditions in the country have also reduced the stock and quality of existing scientists. Achieving set targets and milestones are therefore difficult under these conditions.

  Establishing vibrant resource centres can assist in mitigating R&D capacity risks. Such a long term and collaborative programme should be overseen by a strong board and should be submitted to periodic monitoring and evaluation.

- *R&D funding risk.* Funding for R&D has always been in short supply in Nigeria. This may be more so for research on futuristic energy systems. Leveraging adequate financial resources to launch and sustain R&D programmes, including the proposed NERDP will therefore be challenging.

  Part of the failure to raise enough financial resources for R&D efforts in Nigeria is the over-dependence on public budgets. A mitigation strategy will focus on expanding the scope for funding by actively engaging international agencies, the private sector and fostering international collaboration among R&D centres.

5.7 Environmental Risks

Despite the known fact that renewable energy represents a cleaner alternative, certain environmental risk occurs, and these include:

- *Adverse impact on the environment*. Large and small hydro plants are known for their impacts on aquatic life. Wind turbines also cause noise pollution. Poorly managed biofuel consumption may also result in deforestation. In some situations, the production of liquid fuels from biological sources may consume so much conventional energy that their environmental effects might be enormous. Several environmental tools could be useful in addressing these concerns, and they include environmental impact assessment, environmental audits and environmental management planning.

- *Human dislocation and resettlement*. Hydro power plants are known to cause dislocation to local livelihoods, including farming, fishing and transportation. In severe cases, they lead to resettlement of communities. These environmental trade-offs must be properly assessed, and alternative approaches to meeting energy needs considered.

- *Esthetics*. Several clean and renewable energy forms unfortunately might not be so pleasant to behold. Wind farms, for instance arouse significant resentment by environmentalist, as they seem to deface natural environments. Large PV farms as currently obtainable in Germany and the US also invoke such concerns, handling of domestic waste such as excreta for biogas generation will as well pose some problems.

6.0 CONCLUSION

This 2nd edition of the renewable energy master plan (REMP) which is concise and precise is contained in six chapters. The first chapter is an introduction, which articulates reasons for the review, drivers of renewable energy and the renewable resources in the country.

The renewable energy programmes for the provision of electricity, fuels and heat, and their targets and timelines in the short, medium and long terms are provided in the second chapter. The third chapter expatiates on the action plans that would facilitate the attainment of the targets within the timelines. Incentives for the promotion of renewable energy are articulated in the fourth chapter, while a risk analysis is carried out 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 (biofuels) is to meet 10% - 20% of the national fuel supply. Biomass, and indeed fuelwood, would continue to play significant role in meeting the domestic heat requirements. However, dependence on fuelwood is expected to decline over the years.