National Renewable Energy Action Plans (NREAPs)

(Ghana)

Period [2015-2020]

Within the implementation of the

ECOWAS Renewable Energy Policy (EREP)

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Contact:

Ministry of Power

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Table of Contents

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AECID	Agency for International Cooperation and Development (Spain)
AFD	Agence Française de Développement
BFC	Biofuel Committee
CAP	Country Action Plan
CAPEX	Capital Expenditure
CBO	Community Based Organizations
CC	Climate Change
CEPS	Customs Excise and Preventive Service
COTVET	Council for Technical, Vocational and Education Training
CSP	Concentrated Solar Power
CWE	China Water Electric
DDO	Distillate Diesel Oil
DP	Development Partners
EA	Energy Access
EC	Energy Commission
ECG	Electricity Company of Ghana
ECOWAS	Economic Community of West African States
ECOW-GEN	ECOWAS Programme on Gender Mainstreaming in Energy Access
ECREEE	ECOWAS Center for Renewable Energy and Energy Efficiency
EDEEB	ECOWAS Directive on Energy Efficiency in Building
EE	Energy Efficiency
EEEP	ECOWAS Energy Efficiency Policy
EPA	Environmental Protection Agency
EPC	Enclave Power Company
EREP	ECOWAS Renewable Energy Policy
ERuEP	ECREEE Rural Electrification Programme
ESM	Environmental Sound Management
ETBE	Ethyl-tertio-butyl-ether

ETU	Electricity Transmission Utility
FIT	Feed-in-Tariff
GCMC	Ghana Cylinder Manufacturing Company
GDP	Gross Domestic Product
GEDAP	Ghana Energy Development and Access Projects
GIPC	Ghana Investment Promotion Council
GLSS	Ghana Living Standard Survey
GRIDCO	Ghana Grid Company
GSA	Ghana Standards Authority
GSB	Ghana Standard Board
GSGDA	Ghana Shared Growth Development Agenda
GWh	Gigawatt-hour
ha	hectare
ICS	Improved Cook stoves
IPP	Independent Power Producer
KNUST	Kwame Nkrumah University of Science and Technology
ktoe	kilotonne of oil equivalent
kV	kilo Volt
kVA	kilo Volt Amperes
kW	kilo Watt
kWh/m^2	Kilo Watt hour per square metre
LI	Legislative Instrument
LPG	Liquefied Petroleum Gas
m/s	metre per second
MDGs	Millennium Development Goals
MEPS	Minimum Energy Performance Standards
MMDA	Metropolitan, Municipal and District Assemblies
MoEP	Ministry of Energy and Petroleum
MoFA	Ministry of Food and Agriculture
MoP	Ministry of Power

MSA	Meteorological Service Agency
MTBE	Methyl—tertio-butyl-ether
MVA	Mega Volt Amperes (1,000,000 Volt Amperes)
MVE	Monitoring Verification and Enforcement
MW	Mega Watt
MWh	Mega Watt hour
NEDCo	Northern Electricity Distribution Company
NEEAP	National Energy Efficiency Action Plan
NES	National Electrification Scheme
NITS	Network Integrated Transmission System
NPA	National Petroleum Authority
NREAP	National Renewable Energy Action Plan
OPEX	Operating Expenditure
PPO	Pure Plant Oil
PPP	Public Private Partnership
PSFM	Participatory and Sustainable Forest Management
PUE	Productive Use of Energy
PURC	Public Utilities Regulatory Commission
PV	Photovoltaic
RE	Renewable Energy
RET	Renewable Energy Technology
SAPS	Stand-alone Power Systems
SE4AII	Sustainable Energy for All
SHS	Solar Home System
SHW	Solar Hot Water
SMEs	Small to Medium Enterprises
SNEP	Strategic National Energy Plan
SPPD	Strategic Planning and Policy Division
SREP	Scaling Up Renewable Energy Programme
SSHP	Small Scale Hydro Power

SVO	Straight Vegetable Oil
TEU	Technical Education Unit
TGC	Tradable Green Certificates
TOF	Trees on Farms
TPES	Total Primary Energy Supply
UNIDO	United Nations Industrial Development Organization
VAT	Value Added Tax
VRA	Volta River Authority
VRPP	Variable Renewable Power Plant
WACCA	West African Clean Cooking Alliance
WAGP	West Africa Gas Pipeline
WAPP	West African Power Pool

1 INTRODUCTION

The ECOWAS Renewable Energy Policy (EREP) and the ECOWAS Energy Efficiency Policy (EEEP) were adopted by the ECOWAS Member States in October 2012 and the ECOWAS Heads of States on 18 July 2013. The policy documents were prepared with technical support from the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and a broad range of international partners (UNIDO, EUEI-PDF, GEF-SPWA, Austria, and Spain). The policies include minimum targets and scenarios for renewable energy (RE) and energy efficiency (EE), as well as measures, standards and incentives to be implemented at both regional and national levels.

The EREP foresees the development of National Renewable Energy Action Plans (NREAPs) by the end of 2014 by all fifteen ECOWAS member states. The five-year rolling NREAPs will contribute to the achievement of the regional EREP targets by 2020. The NREAPs have been prepared by the ECOWAS member states in accordance with a template provided by ECREEE. The NREAPs include baseline data on the status of renewable energy development, and propose attainable and renewable energy targets, incl. gender disaggregated indicators based on national potentials and socio-economic assessments. Moreover, an overview on concrete laws, incentives and measures to be implemented by the country to achieve the targets has been included. The implementation of the NREAPs will be monitored by the Ministry of Energy and ECREEE on behalf of the ECOWAS Commission during a continued consultative process. The NREAP template was prepared with technical assistance from ECREEE and UNIDO. The NREAP development process has been supported by a broad range of partners such as the GEF Strategic Programme for West Africa, GIZ, IRENA, the Governments of Austria and Spain.

2 SUMMARY OF NATIONAL RENEWABLE ENERGY POLICY

2.1. Background and achievements

Ghana is endowed with substantial renewable energy potential including solar, wind, biomass and hydro resources. However, its full potential is yet to be tapped except in the case of biomass which provides over 60% of the country's energy resources. For the purpose of security of supply; to avoid over exploitation of the forest resources and for other economic and social benefits, the Government has decided to develop the other renewable resources.

In addition, the Government is committed to the sustainable development and productive use of renewable energy to address energy access issues, contribute to the fight against climate change, resolve sanitation problems and to create green jobs for Ghanaians.

As a result of this enabling environment in terms of fiscal/social regulations, laws and policies, have been developed to educate, promote, and support the development of renewable energy resources. Based on this, the policy of the Government is to increase the share of renewable energy in the electricity mix to 10% by 2020. Its percentage share was 0.2% in 2013 and its current[1] (2015) level is 0.3%.

Renewable energy resources currently being managed are wind, solar, biomass, ocean energy and hydropower. Considerable research work has been completed on each of the resources mentioned and in some cases, sustainable exploitation has already begun. Generally, research has shown that the development of renewable energy resources is constrained by a number of challenges, notably:

i. High upfront capital cost;

ii. Inadequate financial solutions in terms of affordability and sustainability;

iii. Challenging and relatively untested regulatory and legal framework; and

iv. Limited capacity to operate, maintain and manage renewable resources.

To overcome these challenges and in order to sustainably exploit and efficiently use renewable energy resources, the Government of Ghana, in partnership with the donor community and independent power producers, has aligned with ECOWAS regional policies and initiatives to develop the following resources:

Wind: Wind as a renewable energy resource has been researched by the Energy Commission to establish its viability for commercial exploitation. In partnership with the donor community the following initiatives are ongoing to sustainably exploit the country's wind energy resource:

i. The World Bank / MoP / GEDAP programme has been conducting wind resource assessment (WRA) at 60m above ground and more since 2012 in eight (8) locations along the coast in Ghana, namely:

[1] The current level refers to May, 2015.

Mankoadze (Central Region), Sege (Greater Accra Region), Atiteti, Denu and Anloga (Volta Region). Others are Ekumfi Edumafa, Gomoa Fete in the Central Region and Avata (Volta Region).

ii. The VRA plans to install up to 150 MW of wind farms by 2020 and has commenced WRA at 80m above ground at eight (8) locations across the country;

iii. A Swiss company, NEK/Upwind Ltd has secured a provisional license to conduct a feasibility study to establish a 250 MW wind farm;

iv. EleQtra/InfraCo is also conducting WRA to develop a 30 – 50 MW wind farm by 2020 at a site already secured.

Ocean waves: Potential is now being exploited to produce energy. In 2014 a Ghanaian company in partnership with a Swedish Energy Company began the installation of a 14 MW Tidal Wave Plant at Ada Foah, at the estuary of the Volta River into the Gulf of Guinea in Ghana.

Biomass*:* Biomass resources that are available in Ghana includes woodfuels, sawmill residues, briquettes and municipal waste. Biomass resource covers about 20.8 million hectares of the landmarks and is the source of about 60% of the total energy consumed in the country.

Municipal waste is generated in large quantities in Ghana, especially in the cities; on average it is estimated that between 150kg and 200kg per capita of municipal solid waste is generated annually in Ghana. However, municipal solid wastes are yet to be fully harnessed for energy production. Currently, 2015, there are only four engineered landfill sites in Ghana: Tema, Kumasi, Takoradi and Tamale. However, none have started producing energy as of yet.

On a smaller scale, biomass-fired co-generation plants have been installed in four (4) palm oil production company sites (Kwae, Juaben, Benso and Twifo) producing a combined total of 12.3 GWh annually.

Solar: Ghana is well endowed with favourable solar resources ranging from 4.5 – 6.0 kWh/m^2/dayof solar radiation which is very conducive to the installation of solar energy systems such as solar PV, water heater, drying and cooking systems. The total existing installed capacity of solar PV is estimated to be about 5 MW of which 3.3 MW are grid connected systems. The newly installed PV plant at Navrongo (2.5 MW), upper east region is also connected to the national grid. Other installed solar energy plants in Ghana include the Noguchi's 0.72 MW plant at Legon in Accra. There are several pipeline renewable energy projects underway including a 20 MW solar PV plant under construction in Winneba and a 14 MW tidal wave project at Ada Foah.

As a contribution towards the attainment of the 10% renewable energy target in the electricity mix by 2020 and to pursue the SE4ALL Action Agenda by 2020, the following solar programmes and activities have been initiated:

i. The Energy Commission has issued site clearance permits to 15 independent power producers (IPPs) for utility scale power projects;

ii. The Ministry of Power and the Energy Commission are developing a new private-led framework to promote the installation of about 200,000 solar home systems (SHS) through net metering;

iii. There is also the Solar Lantern Promotion Programme (SLAP). This programme aims to promote the distribution of 2,000,000 high quality solar lanterns in deprived and remote off grid communities by 2020. Since 2013, 80,000 have been procured and over 50,000 of them sold with a 50% subsidy;

iv. To support energy access, renewable energy is being used to provide electricity to island and lakeside communities that are not viable for connection to the national grid in the immediate future.

Hydroelectricity: The country's hydropower resource potential is estimated at 2,000 MW. The Akosombo and Kpong hydroelectric plants on the White Volta and the Bui plant on the Black Volta have a total installed generation capacity of 1,580 MW. There are 22 exploitable mini-hydro sites identified in the country with an estimated total potential between 5.6 MW and 24.5 MW. Hydroelectric plants of over 10 MW are possible on 17 sites[2] on the Black Volta, White Volta, Oti River, Tano River, Pra River and Ankobra River.

The main challenge restraining the development of this source of energy is the unavailability of essential data to determine the viability of the site. To overcome these, the Government has initiated the following programmes in partnership with donor agencies:

i. The Swiss Government through SECO is funding a Hydropower Sustainability Assessment Project (HSAP) on six hydropower sites on the black and white Volta Rivers. These sites are Lanka, Ntereso, Koulbi, Daboya, Kalpawn, and Jambito with an aggregated exploitable capacity of 362 MW;

ii. The Agence Française de Developpement (AFD), the World Bank and the Volta River Authority (VRA) are jointly funding various aspects of ongoing feasibility studies on the Pwalugu (40 MW potential) and Juale (90 MW potential) hydropower sites;

iii. China Water Electric (CWE) and Bui Power Authority have funded the full feasibility study of Hemang (60 MW potential) hydropower project;

iv. The African Development Bank and the MoP/GEDAP are in the process of commissioning pre-feasibility studies on 10 additional small and medium hydropower sites with an aggregated exploitable capacity of 248 MW.

As part of the enabling environment created to support the sustainable exploitation and efficient use of renewable energy resources, the Renewable Energy Act, 2011, Act 832 was passed containing some incentives, such as a feed-in-tariff mechanism for renewable energy production. This mechanism guarantees:

i. A feed–in-tariff rate;

ii. A renewable energy purchase obligation; and

A connection to the transmission and distribution systems.

Besides the RE Act 2011, the following acts have also been enacted to promote the sustainable development of RE:

- Energy Fund Act 1997, (Act 541) to promote the development and efficient use of RE;

[2] These sites are recommended by engineering studies, other studies such as EIA or socio-economic impact analysis etc. have not been done yet.

- Public Procurement Act 2003, (Act 663) an economic instrument to promote direct investment in REM
- Ghana Investment Promotion Council Act 2013 (Act 865)- provides tax incentives for investments located outside industrialized centres;
- Value Added Tax Act 2013, (Act 870)- provides exemption for RE energy equipment imported in parts into the country.

3 SUMMARY OF TARGETS[3]

This document provides targets up to 2020 since the national targets for 2030 are yet to be defined by the Strategic National Energy Plan which is currently under review. Therefore, renewable energy targets between 2010 and 2020 only are presented topically below. Within each section the status achieved and the projected targets have been indicated.

Grid connected RE

As at 2013, the total installed capacity of renewable energy was 1,582.5 MW representing 51.4% of the total installed energy generating capacity in Ghana. The country intends to increase the amount to 4,408.5 MW by 2020 representing 88.2% of that year's forecasted national generating capacity of 5,000 MW. This is premised on the determination and commitment of the Government as demonstrated by the number of enabling policies and regulations, as well as the fiscal and legal environment the Government has created. The details are presented in Table 1 below.

Table 1: Targets for grid-connected RE

Installed capacity (MW)	2013*	2020**
Renewable energy installed capacity in MW (including large and medium scale hydro): *	**1,582.5**	**1,587**
• Large and medium scale hydro installations;	1,580	1,580
• PV installations.	2.5	7.0
Renewable energy share of the total installed capacity in % (including medium and large hydro)**	51.4	88.2
Generation (GWh)	**2013**	**2020**
Total renewable energy generation in GWh (including medium and large hydro) *	**11,776.5**	**32,806.6**
• Hydro installation working at 85% capacity (1 MW = 7.45	11,771	*32,791.2*

[3] Ghana prepared a 30-Year Strategic National Energy Plan which ends in 2020. The plan is yet to be reviewed to enable targets beyond 2020 to be set.

GWh); • PV installation working at 25% capacity (1 MW = 2.19 GWh).	*5.5*	*15.4*
Renewable energy share in the electricity mix in % (including medium and large hydro)***	0.2	10.0

Source: *Energy Commission Energy Statistics, 2014 (Table 3.1 & 3.2)

**Energy Commission SPPD projections provided basis for total installed capacity and % was calculated by author

***Installed capacity converted to electricity generation at 1 MW=8.76 GWh at 100%[4].

Table 2: Targets for domestic cooking energy

	2015[5]	2020
Share of population using improved cookstoves in %	4.0	6.7
Share of charcoal produced using efficient charcoal production technologies in %	0.06	0.1
Use of modern fuel alternatives for cooking (e.g. LPG, biogas, solar cookers, ethanol gel fuel, etc.) - % of population*	4.0	6.7

*There is base data only for LPG, therefore projections are for LPG only

Solar water heaters for sanitary hot water and preheating of industrial process water:

A regional SOLtrain programme led by ECREEE conducted a market survey in Ghana in 2015 which showed that the total installed capacity for solar water heater systems is 1037.1 m^2. However, the total generating capacity is 725.8 kW_{th}. The sector with the highest consumption of solar water heater energy is the hospitality industries accounting for 60% of the total consumption, followed by industrial consumption with 31.3%. The data shows that institutional installations have yet to be developed and it is the objective of the Government to install 30,000 solar systems, at a cost of up to USD 25 million, in institutions such as schools, hospitals and clinics in remote areas by 2020.

[4] Source: www.answers.com/Q/convert GWh to MW (17/7/15)

[5] It is estimated that about one million persons are using improved cookstoves as of 2015 and the official target is to reach 2 million by 2020. The estimate was based on the number of years the cookstoves have been promoted in the country. It is therefore not based on any empirical study.

Table 3: Solar water heater systems and capacities 2015[6]

Sector	Capacity m^2	Capacity kW_{th}	% of kW_{th}
Domestic/Residential	86.4	60.4	8.3
Institutions	4.1	2.8	0.4
Industrial	324.3	227.0	31.3
Hotels	622.3	435.6	60.0
Total	**1037.1**	**725.8**	**100.0**

Source: Koforidua Polytechnic, Market Report on Solar Thermal Water Heating and Drying of Agricultural Products, 2015

Biofuels

An earlier attempt was made to develop biodiesel for fuel in Ghana, with the objective of blending diesel on the market with 30% kerosene and 20% biodiesel and ,derived mainly from jatropha, by 2010. However, this was not successful as a result of land litigation issues. It is therefore no longer in the RE development plan of the Government to produce biofuels in the immediate future; the policy now is to develop RE from other sources such as wind, mini-hydro, solar and biomass (waste-to-energy). Targets for these are to be defined in the Strategic National Energy Plan which is currently under review.

4 RENEWABLE ENERGY TARGETS AND TRAJECTORIES

4.1 Grid-connected renewable energy targets

Information on 2013 RE installed capacity and generation are presented in Table 4 below, as well as 2020 targets.

Table 4: Targets for grid-connected renewable energy generation in 2020

Installed capacity (MW)	2013	2020
Renewable energy installed capacity in MW (excluding medium and large hydro)	2.5	7
Renewable energy share of the total installed capacity in % (excluding medium and large hydro)	0.1	5.3
Large- and medium scale hydropower capacity installed in MW (more than 30 MW)	1,580	1,580

[6] This is the first national coverage baseline data therefore no projections have been made yet.

Large- and medium scale hydropower (more than 30 MW) share of total electricity generation in %	55.8	33.8
Total renewable energy capacity in MW (including large and medium scale hydro)	1,582.5	1,587
Renewable energy share of the total installed capacity in % (including medium and large hydro)	51.4	31.7
Generation (GWh)	**2013**	**2020**
Renewable energy electricity generation in GWh (excluding medium and large hydro)	3	176
Renewable energy share in the electricity mix in % (excluding medium and large hydro)	0.02	0.72
Large and medium scale hydropower generation in GWh (more than 30 MW)	8,233	6,397
Large and medium scale hydropower generation (more than 30 MW) as share of electricity mix in %	64	26.2
Total renewable energy generation in GWh (including medium and large hydro)	8,236	6,573
Renewable energy share in the electricity mix in % (including medium and large hydro)	64.0	26.9

Source: Preliminary projections SPPD, Energy Commission 2015

The trajectories for the increase of grid-connected RE installed capacity (in MW) and generation (in GWh) are presented below in tables 5 and 6 respectively.

Table 5: National 2020 targets of grid connected renewable energies installed capacity (MW)

	2013	2016	2018	2020
Small hydro (up to 30 MW)*	-	-	-	-
Medium and large hydro (more than 30 MW)	1580	1580	1580	1580
Solar	2.5	27.5	117.7	217.7
Tide, wave, ocean	0	5	10	10
Wind	0	0	0	20
Bioenergy	-	-	-	-
Geothermal	-	-	-	-

Total	**1,582.5**	**1,612.5**	**1,707.7**	**1,827.7**

Source: Preliminary projections by SPPD, Energy Commission, 2015

* Currently (2015), there is a lack of available data required to assess the actual viability of the estimated potential of the small hydro site. The Government of Ghana is seeking support alongside the donor partners to gather the necessary data for the development of these sites. As it is, there is only an estimated potential.

Table 6: National 2020 grid-connected renewable energy generation (GWh)

	2013	**2016**	**2018**	**2020**
Small hydro (up to 30 MW)*	-	-	-	-
Medium and large hydro (more than 30 MW)	8,233	6,398	6,398	6,398
Solar	3	60	255	472
Tide, wave, ocean	-	15	30	30
Wind	-	0	0	47
Bioenergy	-	-	-	-
Geothermal	-	-	-	-
Total	**8,236**	**6,473**	**6,683**	**6,947**

Source: Preliminary projections by SPPD, Energy Commission, 2015

* Currently (2015), there is the challenge of unavailable data required to access the actual viability of the estimated potential of the small hydro site. The Government of Ghana is seeking support with the donor partners to gather the necessary data for the development of these sites. As it is, there is only an estimated potential.

4.2 Off-grid renewable energy targets

In 2010, although 72% of the population had access to electricity, only 64.2% of the population was served with electricity from the grid. The share of the population with access[7] to electricity is projected to reach 100% by 2020, as is presented in Table 7. However, there is little disaggregated data for electricity services to determine the contribution of RE in comparison to other sources, especially between urban and rural areas.

[7] Access to electricity: Determined by whether a household is within reach of grid electricity service whether it is connected or not. While on the other hand, households which are actually served refers to those which are connected to the grid.

Table 7: Contribution of renewable energy to electricity access targets

	2013	2020
Share of population served by electricity services (%) *	70.8	100
Share of population connected to the grid (%)**	70.6	92

Source: * Ministry of Energy

** Abavana G. C: Noxie Consult 2010

Table 8: National 2020 targets and estimated trajectory for rural population served by electricity services

	2010	2013	2015	2016	2017	2018	2019	2020
Total Rural Population (number of inhabitants)	12,113, 594	12,406,652	12,605,952	12,706,800	12,808,454	12,910,922	13,014,209	13,118,323
Rural population served by electricity services (number of inhabitants)	7,268,156	7,443,990	9,832,642	9,911,303	10,246,763	10,328,737	11,712,788	13,118,323
Rural population served by electricity services (% of total)	60	74	78	78	80	81	89	100

*Source: 2010, data from the Population and Housing Census of 2010 Projection is based on the geometric method using the rate of 0.8% rural population growth rate = $(Pt=P1\ (1+r)^t)$

Table 9: National 2020 targets and estimated trajectory for rural population served with electricity services, disaggregated by gender

	2010		2013*		2015		2016		2017		2018		2019		2020	
	W	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**
Total Rural Pop. (no. of women (W) &men (M))	6,202,160	5,911,434	6,352,205	6,054,446	6,454,247	6,151,705	6,505,882	6,200,918	6,557,928	6,250,525	6,610,393	6,300,529	6,663,275	6,350,933	6,716,581	6,401,742
Rural pop. with electricity services (women and men)	3,721,296	3,546,860	4,700,631	4,480,290	5,034,312	4,798,329	5,074,587	4,836,716	5,246,342	5,000,420	5,354,418	5,103,428	5,397,252	5,652,330	6,716,581	6,401,742
Women and men in rural areas with electricity service	60	60	74	74	78	78	78	78	80	80	81	81	89	89	100	100

s (%)																

Sources: Population and Housing Census of Ghana 2010.

*Disaggregated data based on 51.2% of population being women

Table 10: National 2020 targets and estimated trajectory for off-grid RE systems

	2015*	2016	2017	2018	2019	2020
Mini-grids (RE and hybrid) (in MW of installed capacity)	40**	50	60	70	85	100**
PV, pico-hydro and small scale wind systems (MW)	1,100	1,200	1,300	1,400	1,500	16,000***
Total off-grid RE installed capacity (MW)	**1,140**	**1,250**	**1,360**	**1,470**	**1,585**	**16,100**

* The most recent year for which statistics are available.

**Minimum and maximum targets set by the MoP by 2020; Source: Priority areas for Mini & Off grid RE investments, 2015.

***Target set by MoP is for 2020 and **only** for PV community lighting in isolated communities: Source: Priority Areas for Mini & Off grid RE investments, 2015.

4.3 Renewable energy applications for domestic uses

4.3.1 Domestic cooking energy targets

It is estimated that about 66,000 people die annually as a result of using unhealthy cookstoves (Global Alliance for Clean Cookstoves 2012). The Government aims to reduce the number of affected people in the country and has been promoting the use of improved cookstoves and other cleaner alternative cooking fuels. To that end, it is estimated that about 1 million cookstoves are being used currently (2015), and the goal is to ensure that by 2020, 2 million households will be using improved cookstoves . Efficient methods of charcoal production have been researched but they have not been vigorously promoted, the figures available are related to those in the production of charcoal for export. The Government aims to distribute 50,000 LPG cylinders, particularlyto rural communities, by 2020 as part of the efforts to increase energy access by 2020. Tables 11 and 12 define the trajectory and targets for 2020 relevant to energy efficiency in domestic cooking.

Table 11: Domestic cooking energy targets for 2020

	2015	2020
Share of the population using improved cookstoves in %	4.0	6.7
Share of charcoal produced using efficient technologies in %	0.06	0.1
Share of the population using modern fuel alternatives for cooking (e.g. LPG, biogas, solar cookers) - % of population*	4.0	6.7

Source: Energy Commission, Energy Statistics, 2014

Table 12: National 2020 targets and estimated trajectory for domestic cooking energy

	2010	2013	2015	2016	2017	2018	2019	2020
Population served with improved cookstoves (no. of inhabitants in 000's)	NA	NA	1,000	1,300	1,500	1,700	1,900	2,000
Share of total population using improved cookstoves in %	NA	NA	4.0	4.2	4.9	5.6	6.3	6.7
Total charcoal production in tonnes	1,687	1,989	2,204	2,299	2,389	2,473	2,550	2,619
Charcoal production with efficient technologies (yield	NA	119	132	160	167	197	229	261

superior to 25%) in tonnes								
Share of charcoal produced with efficient technologies in %	NA	0.06	0.06	0.07	0.07	0.08	0.09	0.1

Source data 2010 & 2013: Energy Commission, Energy Statistics 2013.

Projection was based on 5.9% rate of increase between 2010 and 2013.

4.4 Biofuels

Targets and measures regarding biofuel will be presented in detail in section 5.2.9.

4.5 Market indicators

Composite data on investment undertaken in the renewable energy sector is irregular, however, the investment prospectus up to 2020 is presented in Table 13. Solar PV systems and small hydro (150-300 MW) are the largest single investment items on the list. The item with the minimum investment cost is the solar stand alone systems to be distributed in remote communities.

Table 13: Investment Prospectus

Renewable Energy	
Utility scale power projects: • Wind 50 – 350 MW; • Biomass/waste to energy 20-50 MW; • Solar PV systems 50 – 150 MW; • Small hydro (150-300 MW)	 300 - 550 m 60 - 150 m 400 - 700 m 450 - 900 m
200,000 Rooftop Solar (including net-metering systems)	250 m
30,000 solar stand alone systems in remote communities	10 - 25 m
Mini-grids (30-42 units)	21 - 38.5 m
PUE: • 500 irrigation schemes (wind and solar powered);	 150 m

• 250 solar crop dryers ; • 50 aquaculture ventures; • 10 medium scale salt production ventures.	100 m

The number of companies licensed in 2015 to provide various services in order to realize the expected investment is presented in Table 14. A total of 109 companies obtained licences for wholesale suppliers and power generation, charcoal export, installation and maintenance and importation of RETs. Among them, those who have supply and generation licenses dominate the list with 61.5% and the least is the briquette export constituting 2.8% of the total.

Table 14: Companies issued with a RE license by type (2015)

Type of license	Number	Percentage
Provisional wholesale suppliers and generation	67	61.5
Charcoal export	12	11.0
Installation and maintenance	23	21.1
Importation	4	3.6
Briquettes Export	3	2.8
Total	**109**	**100**

Source: Energy Commission; Renewable Energy: (www.energycomm.gov.gh, License Register; as at 26/08/2015).

5 MEASURES FOR ACHIEVING THE TARGETS

5.1 Summary policies and measures to achieve targets

Ghana has developed a number of policies and regulations to promote both grid-connected and off-grid renewable energy sources. For each of the policies/regulations, the expected results, the targeted group and the target dates have been stated. These are presented in Tables 15 - 18.

Table 15: Overview of policies and measures for grid connected RE

Name and reference of the	Type of measure	Expected results	Targeted group and or activity	Existing or planned	Start and end dates of the

measure					measure
Energy Fund, EC Act 541	Financial	Energy generation	Investors	Existing	1997
Public Procurement Act 2003 (Act 663).	Economic instrument	Energy generation	Investors	Existing	2003
GIPC-Act 2013 (Act 865)	Regulatory, economic instrument	Energy generation	Investors	Existing	2013
RE Act 2011 (Act 832)	Regulatory	Energy generation	Investors	Existing	2011
GEDAP	Financial	Energy generation	Investors, end-users	Existing	2007-2015
SE4ALL Country Action Plan	Action plan	PUE, cooking	Investors	Existing; update under development	2012-2020
Kerosene lantern replacement programme	Soft	Behavioural change	End users	Existing	2012

Table 16: Overview of policies and measures for off-grid RE

Name of the measure	Type of measure*	Expected results**	Targeted group and or activity***	Existing or planned	Start and end dates of the measure
RE Act 2011, Act 832	Regulatory (licensing)	Energy generation	Investors	Existing	2011
RE Act 2011 Act 832	Funding	Energy generation	Investors	Existing	2011

Table 17: Overview of policies and measures for domestic cooking energy

Name of the measure	Type of measure	Expected results	Targeted group and or activity***	Existing or planned	Start and end dates of the measure
LPG policy (1992)	Regulatory	Optimum level of forest extraction	Investors/ general population	Existing	1992
National Energy Policy 2010 (Energy and	Regulatory (empowerment)	Health and safety of women protected and	Women	Existing	2010

Gender)		promoted			
Reforestation of degraded forest (Ghana Forest Plantation Strategy 2015 - 2040)	Innovative funding source	Forest Plantation Development Fund established from eg. REDD+, Timber Export Levy	Investors and forestry managers	Existing	2015 - 2040
	Action plan to re-forest degraded forest	20,000 ha of degraded forest lands reclaimed	Ministry of Agriculture, Forestry Commission	Existing	2015 - 2040
	Enrichment planting	100,000 ha of under-stock forest reserves enriched	Forestry Commission, local community	Existing	2015 - 2040
	Community participation	235,000 ha of degraded forest land rehabilitated and maintained	Forestry commission, local community	Existing	2015 - 2040

Table 18: Overview of policies and measures for biofuels

Name of the measure	Type of measure*	Expected results**	Targeted group and or activity***	Existing or planned	Start and end dates of the measure
RE Act 2011, Act 832	Regulatory (Licensing)	Energy generation	Investors	Existing	2011
NPA Act 2005, Act 691	Regulatory (pricing)	Energy priced under law	Investors/consumers	Existing	2005
NPA Act 2005, Act 691	Regulatory (Sale)	Energy produced and sold according to regulatory laws	Investors/consumers	Existing	2005
Re Act 2011 Act 832	Regulatory (transportation)	Safety	Investors/consumers	Existing	2011

5.2 Specific measures to fulfil the requirements under the EREP

5.2.1 Administrative procedures and spatial planning

An all-encompassing act, Renewable Energy Act 2011, Act 832 has been passed that empowers the Energy Commission (EC) to authorise, certify and license all procedures leading to production, transmission and distribution of RE power within the national network infrastructure. The Energy Commission oversees the implementation of the entire process.

The Commission is the technical wing of the Ministries of Energy and of Power. The EC proposes all legislations to the Ministries for approval by the Government. There are no regional or local level agents of the Commission and there are no immediate plans to establish regional and local level sub offices. Where it is required, the Commission collaborates with agencies such as the Environmental Protection Agency and the district assemblies to operate at the local levels.

Communication between EC and the public

In the performance of its duties, the Energy Commission interacts with the public through a well-publicised website where all the requirements are clearly defined. The registration forms to obtain a certificate, or any other form of authorisation, can be downloaded from the website, completed and submitted ,otherwise hard copies are obtainable from the EC's office.

All administrative duties in respect to authorising, certifying and licensing RE installations in the country are centralised at the EC office in Accra and the process of acquiring such documents are clear of unnecessary obstacles.

In spite of the centralised nature of its administration, the EC is able to provide comprehensive information and assistance to all clients in a number of ways:

i. The Commission has a well-publicised and regularly updated website with all the relevant information concerning registration procedures and time frames required for each level of action (www.energycom.gov.gh);

ii. The Commission also has the licensing manual that provides guidelines for the application and granting of licenses to service providers within the RE industry;

iii. The Commission runs RE fairs[8] where information on all levels of its activities, including its core functions such as registration and licensing, regulations and available assistanceare made known to the public;

iv. There are occasional radio presentations to respond to FAQs.

Coordination for the different parts of the permitting process

All forms of coordination are done by one technical unit at the EC responsible for the permitting process and licensing. To obtain the final permit, there are four stages to be satisfied before a final permit is issued for operation. These are:

[8] The last RE Fair (West African clean energy and environment and exhibition) was held from 10th to 12th February, 2015 and another RE Fair is slated for 3rd to 5th November, 2015.

i. Provisional License (PL) - a preliminary and temporary license issued to companies that meet the statutory requirements to develop the proposed power project. The issuance of a PL does not imply approval of the proposed power plant, nor does it authorise the construction or operation of the proposed power plant. The acquisition of a provisional license is thus only the first step of the licensing process;

ii. Siting permit - a permit issued when site analysis has been completed and found to be compatible with the requirements of the plant. This includes a geological survey report, health and safety plan, environmental plan, and site layout and right of way approved by the appropriate agencies;

iii. Construction permit - a permit issued when the licensee provides proof of implementation agreements and schedules, plant and machinery specifications, FIT approval by PURC and proof of payment of initial license fees;

iv. Authorisation permit - a permit provided when the licensee presents a supply agreement, an operation and maintenance plan, a safety and technical management plan, a commissioning report and plant drawing and other relevant documentation.

All stages are handled by the single technical unit at the EC and the conditions to be fulfilled and documentation to be submitted at each stage are fully defined in the manual and the registration form. The process requires that each preceding stage be completed prior to the initiation of the following stage. A license at any stage remains valid for one year after which it is revoked, if it is determined that the conditions, defined within the licence manual, are no longer in place. The timeframe for obtaining a permit depends on the applicant's response time. To ensure an effective process and certification, the unit staff handling the procedure are trained and provided with refresher courses to update their skills, and are also provided with information on best practises.

Authorisation procedures and the specificities of the different renewable energy technologies (RETs)

The authorisation procedures take into account the specificities of the different renewable energy technologies, clearly defined in the registration form where the applicant is expected to specify the type of RET permit they intend to apply for. The selected technology must conform to the subsequent information to be provided on the registration form. The specific section of the registration form is presented below:

Section A-5: Type of Renewable Energy Technology: (check all that apply)

Solar energy	Wind energy	Biomass	Hydro power
☐ Photovoltaics	☐ Large wind turbines (>500kW)	☐ Biogas	☐ Pico hydro (≤10kW)
☐ Solar lanterns	☐ Small wind turbines (≤500kW)	☐ Biofuel	☐ Micro hydro (10kW-100kW)
☐ Solar water heaters	☐ Wind pump	☐ Bio-refinery	☐ Mini hydro (100kW-1MW)
☐ Solar collectors		☐ Briquettes	☐ Small hydro (1MW-10MW)

☐ Solar dryers ☐ Solar cookers		☐ Pellets ☐ Charcoal ☐ Gasification	☐ Medium hydro (10MW-100MW) ☐ Large hydro (>100MW)

Source: Registration Form for RE Companies (www.energycom.gov.gh 3/3/15)

Specific incentives for small-scale, decentralised off-grid installations (micro credits)

There are no specific or direct incentives earmarked for small-scale decentralized off-grid installations. All off-grid solar system components (i.e. solar panels, battery, regulator and inverter), irrespective of the size, benefit from exemption on VAT if imported wholly or already assembled although such systems are not exempt from VAT if the components are imported separately. In addition, the RE Act makes provisions for the establishment of a RE fund which, when operational, can be accessed by any operator within the RE sector. The provisions for the RE fund, which are publicised in RE fairs, were published within a section of the RE Act and within the EC website. Further information is obtainable directly from the offices of the Energy Commission. Currently, there are no micro-credit schemes planned specifically for small-scale systems.

Official guidance and training for installations

Some recognised institutions which train technicians and engineers in RETs, such as the Deng Solar Training Center and KNUST Energy Center, are already providing training for solar technicians. Other plans to improve capacity building and certification include the Energy Commission's intention to start licensing solar technicians the aim of the Council for Technical, Vocational and Educational Training (COTVET) to standardize solar PV training in Ghana.

5.2.2 Technical specifications

Support schemes and quality standards

Support schemes are available for access by all investors provided the investor meets all the predetermined requirements such as product quality and standard level . The Energy Commission is mandated to establish and enforce certification and licensing of dealers in Renewable Energy technologies based on predetermined requirements. In conjunction with the Ghana Standards Authority the EC has adopted applicable international standards (ISO standards etc.) by which every RET is assessed and subsequently approved before it is allowed to be imported and installed in the country.

5.2.3 Buildings

Building codes being developed seek to increase the use of renewable energy systems in buildings and developers are being encouraged to adopt the codes in the construction of newly emerging estates so as to incorporate the use of solar panels for power generation and promote designs that allow the capture of sunlight by the buildings during the day in order to minimize the use of electric power.

Currently (2015), the base data on renewable energy installations in buildings is irregular, however, the Government has defined a target to install grid connected solar PVs on 200,000 houses by 2020. In pursuit of this target, the following measures are planned:

i. Conduct a baseline study to establish the number of houses[9] with the type and number of solar panel installations in order to estimate appropriate targets up to 2020;

ii. Liaise with estate developers to determine the number of houses that can be built annually and subsequently budget for the importation of corresponding PV systems;

iii. Build the capacity of technicians to assemble, install and maintain the PV systems through professional training courses;

iv. Enforce and improve the incentive package for the importation, assembly and sale of solar panels (under the GIPC Act 2013, Act 865) in order to increase access to solar panels in the country(the additional incentives planned are to provide financial assistance to importers and subsidize installation cost);

v. Enact appropriate laws to guarantee the sale of excess energy from grid connected system sin private homes through net metering.

5.2.4 Information provision

The act that established the Energy Commission, Act, 1997 (Act 541), among others, mandates it to regulate, manage, develop and promote the utilization of renewable energy resources in Ghana. The EC is further to provide information and guidance to existing and prospective companies and other stakeholders in the electricity, natural gas and renewable energy sectors. There are no other institutions or agencies with this direct legislation for a similar mandate.

To this end, the EC has a website, where it provides access to key energy data and statistics, as well as information on energy efficiency initiatives which it promotes. Publications are also posted on the website, in public areas and circulated in the mass media to inform the public of upcoming events such as energy fairs, seminars, training, and technical or financial support that are available for the energy sector. For example, a RE fair was organized on 3-5 Nov, 2015 where participants were informed and educated on Government policies, new RETs and their benefits and cost implications.

[9] The Government intends to provide 200,000 houses with solar PV systems. The baseline data is intended to determine the existing number of houses with solar PV systems in order to map existing systems which would aid in the development of appropriate future targets as well as direct the distribution of the projected 200,000 new systems.

The act establishing the EC grants it sole responsibility to publish information regarding all types of applicable RETs, including for water heating, their costs and net benefits.

5.2.5 Certification of installers for RE equipment

Training and skill development are considered key factors in ensuring safety in the installation and maintenance of RETs. As such, under the Ghana Electrical Wiring Regulations 2012, (L.I. 2008), installers are required to be trained in electrical wiring and certified to conduct wiring in buildings.

The L.I. 2008 requires the Energy Commission to issue guidelines for the certification process and in conjunction with the Technical Education Unit (TEU) of the Ghana education service, prepare the curriculum for the training and certification. The certification covers internal wiring and electrical installations. The Energy Commission is preparing to license solar installation technicians at the local level and may also take advantage of the RE installation training institutions in the ECOWAS region. COTVET is also in the process of standardizing all PV training in the country (see Section 5.2.1).

5.2.6 Electricity infrastructure development

The Government of Ghana aims to obtain universal energy access by 2020 with RE contributing 10% to the electricity mix (this excludes large and medium hydro systems). It has therefore commenced massive infrastructure development to support generation, transmission and distribution of electricity produced from all sources. To ensure smooth operation that makes room for additional energy in the transmission lines, Legislative Instrument 2008 (LI, 1934) establishes rules and regulations related to electricity transmission (technical, operational and standards of performance) and distribution as well as the security of the system.

In clause 5 (3) of the LI the utility company (GRIDCo) has the mandate to "plan for the expansion of the transmission system to adequately meet the requirements of forecast demand growth, potential generation, customers and reliability standards". The utility is further enjoined under the same clause 5 (h) to 'plan, develop, install and maintain... and coordinate their transmission, expansion and upgrade'. In response to the West African Power Pool (WAPP) Ghana is expanding its grid infrastructure, according to the mandate of GRIDCo, which will invariably support the strategy of increasing electricity access leading towards the universal coverage target by 2020. Currently, it has a total of 4,313.8 km of electricity lines launched, 5% (219.5 km) of which are 330 kV cables. The high thermal capacity of these cables allows for reduction in transmission losses. The transmission network is also equipped with smart grid technology to detect power theft.

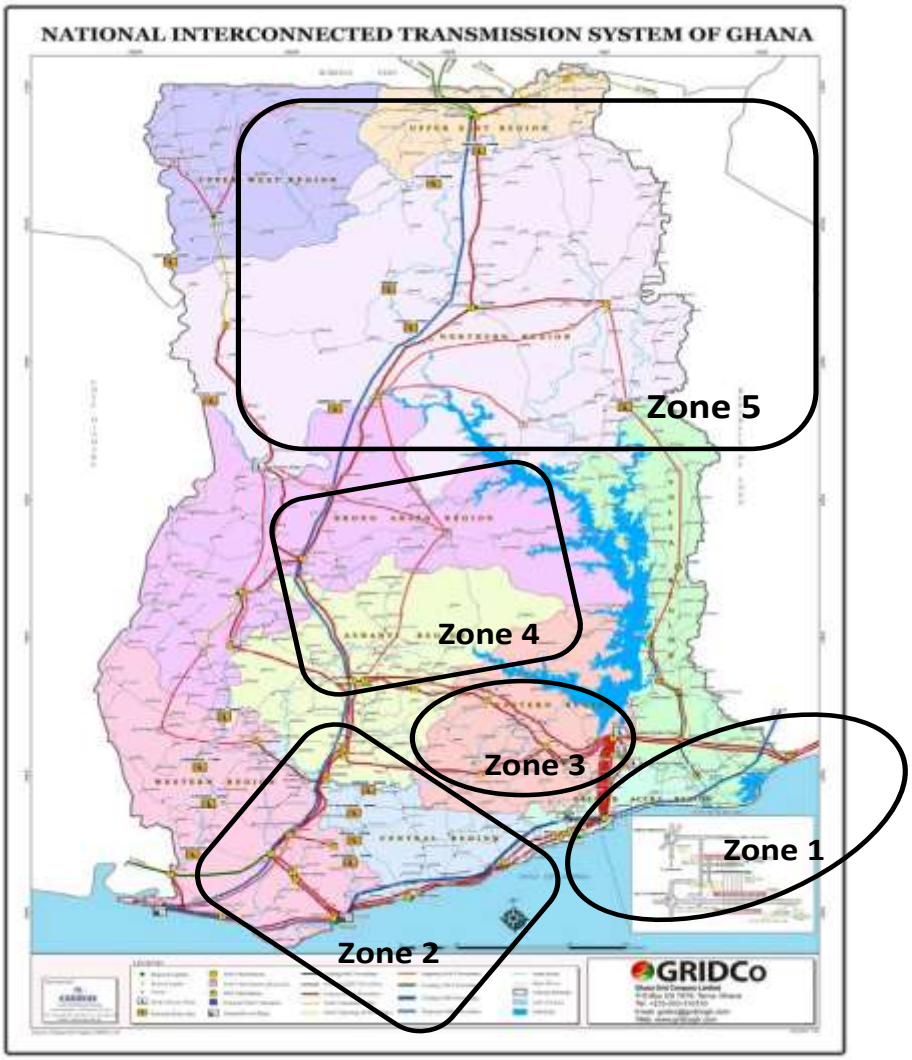
As part of the infrastructure development an independent power producer (IPP) can only be licensed to install up to 20 MW of capacity or must be able to store excess energy in order to protect grid stability. This is explicit in the Renewable Energy Act of 2011, ACT 832 to guide all applicants who intend to invest in RET.

Ghana has developed the grid transmission network connecting the main production to consumption centres, categorized into five zones:

- Zone 1: Greater Accra Region and parts of Eastern, Central and Volta Regions;

- Zone 2: Western Region and part of Central Region;
- Zone 3: Ashanti Region and part of Eastern Region;
- Zone 4: Brong Ahafo Region;
- Zone 5: Northern part of the Country with Northern, Upper West and Upper East Regions.

Figure 1: National interconnected transmission network with electrical zones



Source: Generation Master Plan by GRIDCo, 2011.

In implementing the WAPP agreement, Ghana has established interconnectivity with its neighbours. In 2011, the Ghanaian transmission grid was connected to Côte d'Ivoire (from Zone 2) with a thermal capacity of 327 MVA and to Togo (from Zone 1) with a thermal capacity of 256 MVA. In the northern part of the country, Ghana is also interconnected with Burkina Faso at the 34.5 kV level.

Grid infrastructure approval and other administrative planning procedures are coordinated by the Energy Commission, as mandated by the RE Act 2011 (832). This ensures that there is proper coordination and ease of procedure. To ensure fairness there are no special priority rights given to RE grid participants (a person with a valid connection agreement) over other grid participants who are producing electricity from non-renewable sources. LI 1934 ensures that "transmission system provides fair, transparent, non-discriminatory, open access efficient transmission and delivery of electricity". This may change when the Government eventually implements the tendering system which allows winning bidders to be granted priority.

Under the National Electricity Grid Code, grid participants only pay fees and charges that have previously been published by the electricity transmission utility (ETU) and the dispatch of generating plants shall strictly follow the procedures prescribed in the Scheduling and Dispatch Sub Code (Art 6.09 National Electricity Grid Code 2009). This means that there is no cost sharing between different-time grid participants as none of them pay more or less in being licensed to be connected to the grid.

Further, under the Grid Code, Article 6.01 to 6.05, the ETU shall develop and publish in detail all requirements, qualifications and administrative procedures to be followed by those seeking to become grid participants. The document includes the legal, financial and technical qualifications that must be fulfilled. Copies of the procedure and any other related publications are made available to the public upon the payment of established fees.

The country is divided into four regions and grid participants are free to site their plants in any of the regions. The target is to permit 50 grid participants at the national level. The tendering process, approved by the Government in November, 2015, determines that grid participants who win the bid will have priority in the area of their choice. The details in the entire process are yet to be worked out.

These regulations are to ensure smooth operation, grid stability, and fairness to all grid participants as the country seeks to develop and expand its electricity infrastructure with the dual purpose of increasing access and achieving the targets under the WAPP agreement.

5.2.7 Electricity network operation and guarantee

In order to protect the investment of power producers, particularly those in the RE sub-sector, and also to protect the National Interconnected Transmission System (NITS), some guidelines have been provided under the transmission and distribution sub-codes. The sub-codes define rules and standards that the grid participant shall follow when connecting a variable renewable power plant (VRPP). The obligations of the electricity transmission utility (ETU) are also defined within the sub-codes.

The frequency range of operation, determined within the conditions for technical connection, is specified in the table below. It can be determined from the table that the VRPP, for example, is permitted to stay connected to the NITS within the frequency ranges and time specified.

Table 19: Frequency ranges of operation (conditions to guarantee connection)

Frequency (Hz)	Operation
$47.5 \leq F < 48.75$	90 minutes

48.75 ≤ F < 51.25	Unlimited (continuous range)
51.25 < F ≤ 51.5	90 minutes
51.5 < F ≤ 52	15 minutes

Source: Energy Commission, Renewable Energy sub-code for NITS connection, January 2015

However, the regulation permits the VRPP to be disconnect from the NITS if transmission frequencies occur outside the frequency and time ranges specified in Table 19..

The distribution sub-code has also been defined which aims to ensure safe, reliable and secure operations of all VRPPs connected to the distribution network. Table 20 provides the frequency range of operation within which all VRPPs maintain connectivity connected within the frequency ranges and time specified.

Table 20: Frequency ranges of operation (conditions to guarantee connection)

Frequency (Hz)	Operation
47.5 ≤ F < 48.75	90 minutes
48.75 ≤ F < 51.25	Unlimited (continuous range)
51.25 < F ≤ 51.5	90 minutes
51.5 < F ≤ 52	15 minutes

Source: Energy Commission, Renewable Energy Sub Code for Distribution Network, January 2015

VRPPs shall be capable of staying connected if they are maintained within the frequency ranges and time specified on Table 20.

Rules for charging transmission and distribution tariffs for RE sources[10]

The PURC is responsible for in setting the renewable energy transmission and distribution tariffs rates, otherwise its approval is sought for in writing if another bulk distributer is the buyer. In determining the above mentioned tariffs, the PURC takes into account the following conditions:

i. The technology being used in the RE industry (both technology and renewable source differ among providesr);

ii. Location of the generation facility (this may be determined by the distance to the grid; urban and rural considerations may apply);

iii. Operating norms for the specific technology under consideration;

iv. Costs associated with the construction, commissioning, operation and maintenance of the plant;

v. Reasonable rate of return; and

[10] RE Act 2011; Act 832; clause 27: 3ff

vi. The balance between the interest of the consumer and the investor.

In addition to the above, the feed-in-tariff rate fixed for electricity from renewable sources is guaranteed for a period of 10 years and subsequently subject to review every two years.

5.2.8 Renewable Energy applications for domestic uses

Improved cooking stoves

A baseline report for the improved cookstoves industry in Ghana has been completed by the Energy Commission (2006)[11]. The report identifies local manufacturers of both traditional and improved woodfuel stoves in Ghana, cookstove and fuel distributors and retailers, financial and technical capacity providers, information for consumers, among others.

Based on this, Ghana has adopted standards for improved cookstoves and ten companies have been licensed by the EC to produce these standardized stoves for distribution. Two other companies have also been licensed to import similar stoves for distribution on the Ghanaian market. These stoves are made up of various materials such as clay, metal, bamboo and cement and are meant to promote the efficient use of fuel.

To ensure that the production maintains within established standard, samples of cookstove produced by licensed operators are tested by the Ghana Standard Authority and approved stoves are labelled prior to be placed on the market. Imported products are also inspected and assessed at the entry points by the authorities before being allowed into the market.

Efficient charcoal production standards and compliance

Traditional methods of charcoal production require 4-6 units of wood to produce one unit of charcoal. New and efficient technologies which have varied but higher ratios have been developed but none have been adopted through legislation or an act as a national standard.

When a standard is eventually legislated and adopted, large scale producers will have to comply with the standards and may possibly have to produce the charcoal fromfeedstock before they are licensed.

Use of modern fuel alternatives for cooking

The use of modern and alternative fuels for cooking is being promoted vigorously in Ghana. It is aimed at introducing more healthy cooking fuels, with a particular focus in improving health of women and children who regularly use them for cooking, as well as to improve energy efficiency. Policies and strategies exist to promote modern fuel alternatives for cooking and include the following**;**

LPG: the policy has the initial target of distributing 50,000 LPG cylinders by 2020and as of 2014, 13,000 have been distributed. The strategy for effective implementation is to identify partners at the local levels who will act as

[11] Strategic National Energy Plan, 2006 – 2020, Annex One of Four, July 2006

retailers. Meanwhile the Government is in the process of implementing a gas production and distribution plant at Atuabo to ensure uninterrupted supply of gas.

Solar cookers: Solar as a source of energy for cooking has not yet been effectively exploited in the country.

Solar water heating: Solar energy technology for water heating is gradually gaining acceptance in the Ghanaian market. A recent survey established that the current installed capacity is 1037.1 m^2 with the total generating capacity being 725.8 kW (Table 3). The Government has therefore developed some policies and measures, overview of which are presented in Table 21, to increase use of this source of energy.

Table 21: Overview of policies and measures for solar water heating

Name of the measure	Type of measure*	Expected results**	Targeted group and or activity***	Existing or planned	Start and end dates of the measure
Provide incentives (subsidy) to hotels that install solar water heating systems	Financial	Increased use of RE and reduction in the use of energy from hydro and petroleum sources	Public administration and end users	Planned	2016 - 2030
Introduce solar thermal technology into the science education curriculum & electrical wiring professional training courses	Capacity building	Increased solar thermal technicians to manage solar energy systems: installations and maintenance	Public administration and educational sector	Planned	2016 - 2030

Substitution of kerosene with LPG: The policy aims to encourage users of kerosene for cooking to switch to LPG. The strategy is to supply LPG cylinders to mainly rural communities who rely on kerosene systems. Hence about 70% of the 50,000 cylinders to be distributed by 2020 are destined for rural communities.

5.2.9 Biofuel sustainability criteria and verification of compliance

The sustainable commercial exploitation of Biofuels, a RE source available in Ghana, will reduce the need for importing diesel into the country. Due to its potential, a policy on sustainable exploitation of biofuels has been incorporated into the RE Act 2011; Act 832 and ensures that those licensed to produce biofuel will do so from feedstock. To ensure compliance, the permit will be jointly issued by the Ministry of Food and Agriculture (MoFA) and the Environmental Protection Agency (EPA). Under the policy, the producers will be monitored for compliance by the EC in collaboration with entities that have more widespread staff representation such as the Forestry Commission, EPA, and the Metropolitan, Municipal, and District Assemblies (MMDA). The inclusion of MoFA in the permitting process is to ensure that good agro-environmental practices and other cross compliance requirements are followed and verified at the national level. Biofuel production in commercial quantities has yet to start. Measures that aim to develop production of biofuels include the following:

i. Set up a National Biofuel Committee to educate the public through workshops and media programmes on the market value and environmental importance of biofuel energy by 2016;

ii. Identify convalescence forest land and facilitate the creation of litigation free land banks to grow biofuel feed stock by 2017;

iii. Identify, reclaim and secure all degraded lands due to mining activities to create feed stock for biofuel production by 2017;

iv. Introduce an appropriate legal framework to guarantee a biofuel feed-in-tariff to support the production and marketing of biofuel products by 2018;

v. Build the capacity of stakeholders, such as communities and farmers, in the areas of cooperative commercial tree nurseries, plantation establishment, participation in out grower schemes and cultivation of food crops under Taungya's schemes by 2018.

5.3 Support schemes to promote the use of energy from renewable resources in electricity generation

A number of support schemes have been put in place to promote the use of energy from renewable sources. Some of the these are regulatory schemes that set mechanisms to achieve targets, others are financial support for investment while others are soft measures that provide information, education or awareness creation. The text below is focused on regulatory and financial measures only.

Regulation for grid-connected RE

The National Energy Policy is focused on RE, particularly solar and wind energy (MoE, February 2010). The aim is to:

i. Improve the cost effectiveness of solar and wind technologies;

ii. Create favourable regulatory and fiscal regimes;

iii. Support research and development to reduce the cost of solar and wind energy technologies; and

iv. Support the use of decentralized off-grid alternative technologies to allow for competitiveness with conventional electricity supply.

The objective is to ensure regulated development of solar and wind energy produced from grid connected and stand alone systems. Under the Renewable Energy Act (Act 832) there is a purchase obligation for power generated from RE sources. In order to promote and prioritize solar and wind energy, the following measures are planned:

i. Prioritize the installation of solar and wind systems in remote and undeveloped areas. The Ministry of Energy is responsible for the enforcement of such installations.

ii. Provide financial incentive to harness solar and wind energy at a sustainable cost to both producers and consumers in the rural and coastal areas. This financial incentive is targeted at investors, end users and public administration and aims to promote and increase access to solar and wind energy at affordable cost to remote population segments;

iii. Reduce the cost associated with connecting solar and wind energy to the grid to ensure these are not disregarded for potential grid connection. This will serve as an incentive to producers to implement solar and wind energy farms;

iv. Remove the subsidies on other forms of energy to enable solar and wind energy to become competitive in the energy market. The Ministry of Power is to introduce this policy for the benefit of investors and installers.

These proposals are meant to regulate the energy market in support of increased and sustainable production of RE, particularly solar and wind energy.

The EC is the focal agency for promoting RE production and use. It prepares policies and regulations for the Government and sees to the implementation of all related RE programmes. However, it works in collaboration with the Forestry Commission, when biomass resources are to be exploited, and with the EPA when the assessment of the environmental impact of projects is necessary. The MMDAs, who have the legal authority to control development in their jurisdiction, are also partners.

The strategies of all the programmes are reviewed annually by stakeholders and in the event of non-fulfilment of targets, new strategies are developed.

Financial support

The Ghana Investment Promotion Act 2013 (Act 865) is a major tax reduction of exemption scheme applicable to all investments in Ghana, including those pertaining to RE. This act is an economic instrument meant to exempt or reduce tax for investment based their location, with the main purpose of encouraging and promoting investments, creating an attractive incentive framework and a transparent, predictable and facilitating environment for investments in Ghana. The scheme is managed by the centre in operation since its promulgation in 2011 which is governed by a board that has as its chairman an appointee of the Government with a maximum of two terms only (4 years per term).

Among others, a registered investor benefits from the Internal Revenue Act 2000 (Act 592), which offers tax holidays and eventual tax reduction if investing at certain distances from the urban centres, and also from the VAT Act 1998 (Act 546) where certain categories of goods are tax exempt at the port of entry. An investor may also benefit from potential tax exemptions under the Customs Harmonised Commodity and Tariff Code Act 1993 (PNDCL 330), where non zero-rated equipment is imported. A project that is benefiting under Act 865 is not precluded from benefiting from another act, such as from the Energy Fund incorporated in Act 541.

The tax reduction and exemption scheme guarantees long term security to investment once licensed. If the company has a foreign partner, the license is renewed every two years and unless clauses within the license are breached, the long term operation of the company is assured.

The guarantee and support within the scheme is not technology specific as it is applicable to all forms of technology including wind, solar, hydro, biofuel and biomass systems irrespective of their size. The scheme does not specify measures in relation to energy efficiency and is instead focused on the expected impact, that is, the creation of an enabling environment that attracts investors into the country to support the energy access policies.

The scheme was first enacted by Act 1994, Act 478, and later revised in 2013 as Act 865. It has been in in force since 1994 operating with LI 1547. The scheme has no end dates except although it is to be revised periodically as dictated by future exigencies.

Specific financial support for investment:

The Energy Fund has been established by Act 541 to provide financial resources for the promotion, development, sustainable management and utilisation of renewable energy sources. The fund has a primary application aimed at creating financial incentives, feed-in-tariffs, capital subsidies, production based subsidies and equity participation for the following technologies:

i. Grid interactive renewable electricity;

ii. Mini-grid and off-grid renewable power systems for remote areas and island operation[12];

iii. Renewable energy projects for non-electricity purposes; and

iv. Any other renewable energy activity that the commission may determine.

Even within these specified areas, funds may be applied specifically for investment in the promotion of:

- Scientific, technological and innovative research of renewable energy;
- Research into the establishment of standards for the utilisation of renewable energy;
- The production of equipment for the development and utilisation of renewable energy in the country;
- Programmes to promote international best practices;
- Innovative approaches to the development and utilisation of renewable energy sources; and
- The development of
    i. Infrastructure for renewable energy; and
    ii. Capacity building related to renewable energy development to enable local entrepreneurs to assemble, maintain and distribute RES for sustainable supply.

The above implies that while all licensed operators can apply for the fund, which is continuous and may be applied for at any time, areas of application of the fund are rather restricted. **Feed-In-Tariffs (FIT)[13]:**

[12] Various forms of business models are being tested for all forms of RE sources and will include mini-grid and off-grid RE.

The feed-in-tariff applies to RETs that will produce electricity to be delivered to the national grid for distribution and consumption. Thus stand-alone and off-grid systems do not benefit from any of the feed-in-tariff incentives since those apt to benefit from the FIT must be grid participants. The FIT is guaranteed for a period of 10 years, once granted, after which the terms of conditions are reviewed every two years.

As of February, 2015, fifty-two (52) applicants at various stages of the process to become grid participants have been granted licenses. However, the inability of the Electricity Company of Ghana, the main off-taker, to guarantee the payment of the rate as agreed in the FIT has hindered the implementation of energy production by all the applicants even though the PPA has been signed. The eventual implementation for the tendering process may aid the Government in guaranteeing the agreed rates in order to enable the objectives of the FIT to be achieved.

Financial support schemes for rural electrification

Rural electrification is a major concern for the Government which is the sole financier Governmentof such developement. However, there is no specific fund set aside for RE in rural electrification beside the indirect use of the Energy Fund,the incentives provided under the FIT,subsidies provided for solar home systems (SHS) and tax incentives provided under the GIP Act.

Entrepreneurship development

Besides the financial support under the GIPC there is the need to promote entrepreneurship in the assembly, repair, maintenance, storage, marketing, wholesale and retail distributors of RETs to ensure sustainable supply of the systems to the population. A needs assessment is to be undertaken in targeted communities to identify and to build the entrepreneurship capacities in the localities in order to capacitate local RETs agents. Such entrepreneurs could be supported in order become business incubators by whom others could be trained to promote the development and productive use of the RETs.

5.4 Specific measures for the promotion of efficient cookstoves

Branding

As a marketing strategy, cookstoves have been introduced into the market by various forms of branding. The brands were simple and catchy local names that were attractive and transmitted messages regarding the importance of improved cookstoves. Among them was ‘GYAPA’ which is literally translated as ‘good fire’ and “Aben da da” which signifies “already cooked”. These names imply that ‘once you choose the stove it will turn your wood into ‘good fire’ and ‘before you are aware, the food is already cooked’, both phrases connoting positive experiences.

Promotion

[13] FIT has been discussed in detail under Section 5.5.7

In addition to the branding, promotional adverts were run which included static & dynamic adverts in the media including television. Stickers, posters and flyers extolling the virtues of the improved cookstoves were printed and distributed free of charge. In addition, user manuals were printed and given to buyers on how to operate the systems. The product's operation and maintenance were demonstrated at the community level.

Educational publicity

The public was educated on the benefits of using the improved cookstoves which included such factors as improved health, livelihood, and quality of life due to reduced exposure to air pollution, mainly for women and children.

Entrepreneurship development

Besides the ongoing promotional activities there is the need to support entrepreneur artisans who will assemble, repair, maintain, store and market efficient cookstoves to ensure sustainable supply and productive use of energy among the population. A needs assessment must be conducted in targeted communities to identify and to build the entrepreneurship capacities in the localities that will produce and distribute the cookstoves .

5.5 Specific measures for the promotion of efficient charcoal production

Analysis of the physical characteristics of trees in Ghana reveals that woodfuel from the savannah zone have higher calorific value. Thus, trees from that zone which are not suitable for processing into lumber or veneer are, nonetheless, suitable for charcoal production. In 2013, 1,989 ktoe of charcoal was produced and accounted for 16.2% of energy consumed, out of which, 0.8 ktoe was exported. Even though the rate of consumption and export is generally on the decline, it is a valuable RE source of fuel for the urban residents[14].

Charcoal production, however, is conducted by traditional mounds which do not support sustainable exploitation. For example, it takes 4-6 units of wood (depending upon the type of tree and by the moisture content) to produce one unit of charcoal. Sustainable charcoal production and utilisation programmes are being implemented in a bid to improve PUE from RE sources. Currently more efficient technologies have been introduced to improve the production ratio but have yet to be vigorously promoted.

5.6 Specific measures for the promotion of modern fuel alternatives for cooking

The predominant fuel for cooking in Ghana is biomass as about 60% of energy is supplied by biomass (woodfuel); however, this has health implications and it is the determination of the Government to reduce its use for both health and environmental reasons. As a result, the Government is promoting the use of modern fuel alternatives for cooking through education and distribution of cleaner fuels and stoves. The education involves informing the public, through seminars and community meetings, women's groups in particular, of the positive

[14] Source: Energy Statistics, Energy Commission, 2014

health implications of adapting to new technologies . The campaigns are targeted at households, public catering facilities and small-scale food sellers. Since 2012, efforts have been made to encourage electric stoves users to switch to gas stoves, and those using charcoal to switch to LPG and other energy efficient cookstoves.

Additionally, as of the 2014, the Government has distributed 13,000 LPG gas cylinders (14.5 kg and 5 kg) for free, particularly in rural communities with the aim of reaching the target of 50,000 distributions by 2016 (Petroleum Directorate, MoEP). Furthermore, to enhance fast distribution and delivery of LPG to consumers, the Ministry of Energy purchased and assigned pick-up trucks provided with 50 cylinders each to registered private individuals in order to retail LPG. The demand for LPG grew considerably averaging over 40% between 2000 and 2010.

To ensure the continuous supply of gas, the Government has commissioned the Atoabo Gas Plant which will receive and process natural gas from the oil fields and distribute it to consumers (industry and domestic) in the country. Research is ongoing to identify communities and assess their needs and their level of effective demand and, in addition, to identify focal persons at the local level who can act as sales agents to retail both the cylinders and the liquefied petroleum gas.

A fund, the LPG Fund, was created with a levy placed on LPG purchases to fund the purchase and maintenance of cylinders, LPG tanks and kitchen equipment for institutions. The LPG Fund was used to finance the local component of the cost of constructing the Ghana Cylinder Manufacturing Company (GCMC) factory in Accra.

5.7 Support schemes to promote the use of biofuels

In 2005, the Energy Commission set up the Biofuel Committee (BFC) with the objective of substituting 20% of national gasoil consumption and 30% of national kerosene consumption with jatropha oil by 2015[15]. As of 2007, 15,34 km^2 of jatropha had been cultivated and a target of 10,000 km^2 of degraded land was to be used for the cultivation of the jatropha. However, as a result of land litigation issues that impeded land acquisition, the project has been abandoned. (Source: Essel Ben Hagan: Biofuel Assessment Report, ECOWAS Sub-region, Aug 2007). Currently, the Government has prioritized the development of solar, wind, mini hydro and waste to energy as the primary RE resource for development.

5.8 Specific measures for the promotion of sustainable use of biomass energy

5.8.1 Biomass supply

Ghana has a total land area of 238,539 km^2 from which , 41,000 km^2 (17.2%) was determined to be arable land in 2007. Out of the total arable land 36.7% (87,543.8 km^2) was under permanent cultivation, leaving 150,995 km^2 as unused arable land (Source: en.worldstat.info/Asia/Ghana/land). The Government has initiated the establishment of woodlots and forest plantations during which 500,000 ha of plantation would be established by 2040 on degraded lands estimated to be 3,970 km^2 in 1996 (Ghana Forest Plantation Strategy: 2015-2040, Forestry Commission 2013). The primary focus is to produce round wood for both local and external markets with

[15] Essel Ben Hagan: Aug 2007; Biofuel Assessment Report, ECOWAS Sub-region,

the off-cuts and the residue from the timber industry to be used for charcoal production. The Energy Commission has embarked on creating wood lots in basic schools and so far (2015) a total of 15 ha have been planted.

5.8.2 Measures to increase biomass availability

Biomass from forestry residues:

Biomass from forest residues may come from off cuts from timber and as a by-product from processed timber or agricultural products. Efforts to increase biomass supply (chapter 5.11.2 above) and eventual processing could increase forestry residues. In order to improve forest management techniques to maximize the extraction of biomass from the forest in a sustainable way the following strategic objectives have been planned under the Ghana Forest Plantation Strategy; 2015-2040:

i. Establishment and management of planted forest

The forest plantation will be managed in several forms in a bid to maximize production and guarantee sustainable production and forest protection. Among the methods to be used are planting convalescence[16] areas to enhance the commercial productivity of a degraded forest. Again, trees on farms (TOF) would be practiced where smallholder farmers will be technically supported to practice agro forestry.

ii. Forest plantation investment promotion

In order to improve investment in forest plantation, the Forest Plantation Development Fund will be expanded to cover export of key timber species, and reforestation levy or carbon tax are being considered. This will increase the total amount accruing to the fund for disbursement in developing afforestation.

iii. Employment creation and sustainable livelihoods

Under this strategy, skills of stakeholder communities will be built up in such areas as operation of commercial tree nurseries, plantation establishment, participation in out grower schemes and cultivation of food crops under Taungya's schemes. It is estimated that 500,000 full time jobs will be created over a 25 year period during the establishment of 5,000 km^2 (500,000 hectares) of re-afforestation.

iv. Increase investment in research development

A forest plantation research fund is proposed to be established to provide support to priority research areas. The short to medium term focus of the research would be directed to seed and tree improvement[17].

[16] Convalescence areas in the forest are degraded lands that are in the process of regenerating. They remain as empty patches in the forest cover

[17] Source: Ghana Forest Plantation Strategy 2015 – 2040, October 2013

In order to improve forest management to increase future growth it is proposed that a multi-stakeholder advisory body, the Forest Plantation Technical Steering Committee, be formed to guide the implementation of the forest plantation strategy.(Source: IBID)

Biomass from municipal waste

Under the priority areas for renewable energy investment (grid connected) the Government has a programme to install biomass/waste-to-energy power plants by 2020 with capacities ranging between 50 and 100 MW.

Currently, four municipalities: Tema, Kumasi, Takoradi and Tamale have engineered landfill sites where domestic and industrial wastes are dumped. There are other smaller landfill sites that are designed to produce gas for direct consumption rather than transmitting onto the grid. These include Nsumia Pit and Oblogo facilities. Of the four engineered landfill sites, only the one in Tema is economically viable with the generating capacity of 2 MW for a period of 10 years.

Biogas systems

As a further measure to increase energy access, biogas systems were installed by the Ministry of Energy. As of 2014, forty- nine (49) institutional biogas systems were installed which had capacities ranging between 20m^3 and 450m^3. However, operational challenges such as maintenance and use of the systems have grounded the majority of the systems. The target is to construct 200 biogas systems for cooking in institutions by 2020 but this will be preceded by a thorough evaluation to develop operation and maintenance skills of the users for sustainable use.

Biomass from agricultural waste

There is a lot of agricultural waste including cocoa husks, oil palm husks, groundnut, sugarcane waste, and palm kernel husks. Given the potential, the Government has targeted a 50 – 100 MW installed capacity by 2020. The focus is to contribute to energy supply security. (Source: Priority Areas for RE Investment (Grid connected) MoE 2015).

Attempts are therefore being made to make use of solid biomass to ensure that both agricultural and industrial waste is processed for power generation. The installed plants use palm kernel husk to produce energy for agricultural processing. The challenge in setting up a large plant is the scattered nature of the solid biomass. The cost of transporting the waste from the scattered sources to a production center increases the OPEX, thus few investors are attracted to such projects. However, the provisions in the Feed-in-Tariff mechanism (of Act 832, 2011) could attract investors in the future.

Currently there are four biomass-fired co-generation plants operating in Ghana (See Table 22) with combined installed capacity of 4,034 kW and with an average annual production of 12.3 GWh.

Table 22: Biomass-fired co-generation plants in Ghana

Plant Location	Installed Capacity,	Average Annual Production,

	kW	GWh
Ghana Oil Development Company, Kwae	2,500	6.8
Juaben Oil Mill, Juaben	424	1.5
Benso Oil Mill, Benso	500	1.9
Twifo Oil Palm, Twifo	610	2.1
Total	**4,034**	**12.3**

Source: Energy Commission, 2011

6 ARTICULATION WITH REGIONAL INITIATIVES

The ECOWAS region has a series of on-going regional initiatives in the field of renewable energy:

- The ECOWAS White Paper on a Regional Policy for Increasing Access to Energy Services in Peri-Urban and Rural Areas by 2015;
- Establishment of ECREEE;
- Adoption of the ECOWAS Renewable Energy Policy (EREP) with targets for 2020 and 2030;
- The ECOWAS Small Scale Hydropower Programme;
- The ECOWAS Solar Thermal Program
- The ECOWAS Bioenergy Strategy Framework;
- The ECREEE Rural Electrification Programme; and
- West African Cooking Alliance (WACCA).

A summary of these regional initiatives in renewable energy can be found in Annex I of this Plan.

Besides the activities in renewable energy, the ECOWAS region also has a series of on-going activities in energy access:

- The ECOWAS White Paper on a regional policy for increasing access to energy services in peri-urban and rural areas by 2015
- The ECOWAS revised generation and transmission master plan ;
- The West Africa Gas Pipeline (WAGP);
- ECOWAS rural electrification projects.

A summary of the regional initiatives on energy access can be found in Annex II.

7 PREPARATION OF THE NATIONAL RENEWABLE ENERGY ACTION PLAN AND FOLLOW-UP ON ITS IMPLEMENTATION

The preparation of the National Renewable Energy Action Plan began after the process agreed upon during a regional kick off workshop in Abidjan from 17th - 19th March, 2014. Based on the process, an inception report (with contents defined) was submitted on schedule.

According to the schedule, a 7-member expert group was formed which was an increase in the personnel compared to the existing group at the Energy Commission. The Commission had the full mandate of the Ministry of Energy. The membership of the working group is:

1) Mr. K A. Otu Danquah — Head, Renewable Energy Division - Chairman
2) Mr. Anthony Bleboo — Head, Technical Regulation Division
3) Mr. Julius Nkansah-Nyarko — Snr. Programme Officer, RE Division (Bio Energy)
4) Dr. Joseph Essandoh-Yeddu — Chief, Strategic Planning and Policy Division
5) Mr. Kofi Agyarko — Head, Energy Efficiency Promotion
6) Miss Paula Edze — Coordinator, SE4ALL
7) Mr. Kwasi Opoku — Consultant

With the support of the expert group a baseline report was prepared. During the preparation of the baseline report, there were other stakeholder institutions identified to provide input for the study. These included: the Ministry of Agriculture, the Forestry Commission, the Aviation Department of the Ministry of Transport, the Railways Corporation, the Electricity Company of Ghana, GRIDCO, VRA, the National Council for Tertiary Education, the Ghana Standards Authority and the Ministry of Women and Children Affairs. These institutions and departments were individually contacted for the relevant data that completed the report.

In accordance with the process agreed upon in Abidjan, an international team of experts were contracted by ECREEE to support the development and review of the action plans which included NREAP, NEEAP and the SE4ALL Action Agenda. The baseline report provided the basic information for the preparation of all the plans.

With the NEEAP, as with the other plans, draft reports were circulated by the consultant to the local and the international team of experts (the Ministry of Energy was also copied) who provided comments and suggestions that cumulated into this final draft for a national validation workshop.

Implementation body

An inter-ministerial committee has been inaugurated to implement the SE4ALL Agenda. The committee is made up of the Ministry of Power, the Ministry of Petroleum, the Ministry of Food and Agriculture, the Ministry of

Fisheries and Aquaculture Development, the Ministry of Health, the Ministry of Environment, Science and Technology and Innovation, and the Ministry of Gender, Children and Social Protection. This committee is chaired by the Minister of Power. Since the NREAP and the NEEAP are an integral part of the SE4ALL Agenda, the committee will have an oversight responsibility in the implementation of the NREAP and the NEEAP.

ANNEX I – REGIONAL INITIATIVES IN RENEWABLE ENERGY

The ECOWAS White Paper on Increasing Access to Energy Services in Peri-Urban and Rural Areas by 2015

The ECOWAS White Paper was adopted in 2006 by the ECOWAS Heads of States and Government in recognition of the key role that energy plays in the achievement of the Millennium Development Goals (MDGs). The White Paper aims to provide access to improved domestic cooking fuels and sustainable electricity services for the majority of the population by 2015. Moreover, it foresees that at least 20% of new investments in electricity generation should originate from locally available renewable resources, in order to achieve self-sufficiency, reduced vulnerability and sustainable environmental development.

The ECOWAS Energy Protocol

The ECOWAS Energy Protocol is a legal text that formalises the juridical framework of enterprises in the energy sector that was modelled after the European Energy Charter Treaty. It promotes investment and trade by serving as a security for foreign direct investments in the energy sector. The ECOWAS Member States have completed the process of ratifying the Protocol which aims to provide a legal and regulatory framework for all regional energy integration initiatives and projects

The ECOWAS Bioenergy Strategy Framework

The ECOWAS Bioenergy Strategy Framework, adopted by the ECOWAS Council of Ministers in June 2013, aims to enhance the sustainable Bioenergy production and use within the Region that help address energy poverty, particularly in the rural and peri-urban populations, promotes food security, safeguard the environment, and enabling domestic and foreign investments. Development of National Action Plans should take into consideration the following objectives and initiatives:

- Universal access to modern energy services, especially in the rural and peri-urban areas by 2030 ;
- A more sustainable and safe provision of domestic energy services for cooking thus achieving the objectives of the White Paper for access to modern energy services by 2020 and
- Increasing food security within the region.
- Promote the transition from the traditional use of biomass towards a modern, efficient production and use of modern Bioenergy;
- Broaden regional dialogue and peer-to-peer learning to support the development of Bioenergy strategies in the ECOWAS Member States ;
- Promote regional policy planning for Bioenergy harmonized with national policies;
- Sensitize and share experiences on modern sustainable Bioenergy production that also promotes food security; and
- Create a vibrant and sustainable modern Bioenergy sector that promotes economic growth, rural development, and poverty alleviation.

The ECOWAS Small-Scale Hydropower Program

THE ECOWAS Small-Scale Hydropower Program, adopted by the ECOWAS Council of Ministers in June 2013, aims to contribute towards increased access to modern, affordable and reliable energy services by establishing an enabling environment for small-scale hydro power investments and markets in the ECOWAS region.

Between 2013 and 2018 the following specific program objectives will be achieved:

- At least six ECOWAS countries will have improved their legal framework (poverty reduction impact of SSHP evidence in their legal framework, feed-in tariff defined, transparent licensing procedure etc.);
- ECOWAS Member States integrate SSHP into their scenarios, planning documents and budgetary allocations;
- National SSHP initiatives and projects increasingly rely on local expertise from public and private sector (with limited international support). At least 1000 experts are trained.
- Quality guidelines are in use and quality of SSHP project proposals and feasibility studies improved.
- SHPP, planning tools and all other SHPP related publications are available on the ECREEE website.
- A least 35 additional SSHP projects per year are developed up to feasibility study level. The construction of 50 projects has commenced. The more funding is mobilized the more projects can be developed.
- At least 10 companies established to provide various SSHP related services (planning, operation, repair etc.).
- Sustainability criteria and biodiversity offsetting will be mainstreamed throughout the planning and construction of SHP plants.

ECREEE Rural Electrification Programme (ERuEP)

The implementation of ERuEP will be done based on the four main pillars of ECREEE work programmes:

- Policy support (P);
- Capacity development (C);
- Project Development and Financing (D);
- Knowledge management (K).

These four pillars are vastly interlinked, and their importance for programme development in ECREEE is that, it allows for planning to take into account all the aspects needed for a successful implementation. A feasible initiative must include policy mechanisms, capacity building initiatives, promote the development and financing of specific projects and appropriate knowledge management, starting with awareness raising and knowledge sharing.

The main activities to be undertaken in the rural electrification initiative include:

1 Support Member States in setting up the enabling environment and institutional framework for Mini-grids.

- Support MS in analysis and planning of rural electrification through GIS based rural electrification planning
- Support the identification of national tailored approach to rural electrification
- Support the establishment of appropriate institutional and legislative framework
- Promote an enabling environment for private sector involvement
- Promote regional policy on rural electrification

2 Strengthen the capacities on sustainable management, operation and maintenance of existing systems

- Technical and entrepreneurial training to build capacity on local manufacturing of components
- Mentorship to entrepreneurs

- Support project preparatory activities
- Support Governments in fund mobilisation
- Direct support to implementation through EREF calls

The ECOWAS Programme on Gender Mainstreaming in Energy Access (ECOW-GEN)

The ECOWAS Programme on Gender Mainstreaming in Energy Access (ECOW-GEN) was established against the background that women's potential, in the ECOWAS region, as producers and suppliers of energy services is under-utilized and that empowering women to make significant contributions in the implementation of the adopted regional renewable energy and energy efficiency policies is necessary for the achievement of the Sustainable Energy for All (SE4ALL) goals in West Africa. Moreover, the programme is founded upon the principles of the ECOWAS Gender Policy which emphasizes the "need to develop policies and programmes to provide alternative energy sources which would contribute to women's health and also alleviate their time burden".

To stimulate the development of women-led business initiatives in the energy sector, ECREEE, through the support of the Spanish Agency for International Cooperation and Development (AECID), established the ECOWAS Women's Business Fund. ECREEE will work with Member States to identify and support, through the fund, innovative energy projects implemented by women groups and associations. In addition to this, ECREEE will assist Member States to establish similar funds in their respective

The ECOWAS Solar Thermal Program

The overall goal of the Solar Thermal Program (SOLTRAIN) in West Africa is to contribute to the switch from a fossil fuel based energy supply to a sustainable energy supply system based on renewable energies in general but based on solar thermal in particular. The overall project will be coordinated by ECREEE and technically implemented by AEE INTEC in cooperation with 8 institutional project partners from 7 West African countries (Cape Verde, Nigeria, Burkina Faso, Ghana, Mali, Senegal, Niger and Sierra Leone).

The ECOWAS solar thermal capacity building and demonstration program therefore aims to remove existing awareness, political, technological, and capacity related barriers which restrict solar thermal energy deployment in ECOWAS countries. The program will also contribute to increase the grid stability and save national power reserves as solar thermal systems will significantly reduce the stress on electric grids due to the shift from electricity to solar energy. The program links precisely to the goals of the regional polices on Renewable energy and energy Efficiency adopted by the ECOWAS Authority of Heads of State and Government in 2013. The regional policies considered solar thermal as a least cost sustainable energy technology and set specific targets for its use to meet sanitary and industrial hot water needs in the region.

The goals of SOLtrain West Africa are:

- Capacity Building by theoretical and practical Train-the-trainer courses to selected universities and polytechnic schools in the area of solar water heating and solar thermal drying
- Identify, monitor, analyze and improve existing solar thermal systems together with the partner institutions (practical training).
- Technical support of local producers.
- Design and Install solar thermal systems on the partner institutions for teaching and demonstration purposes.
- The partner institutions will offer trainings to national companies, installers, producers and further training institutions within their countries.
- Installation of 200 Demonstration systems at social institutions as schools and hospitals engineered by the partner institutions and installed by national practitioners

- Trainings to administrative, political and financial stakeholders in each country
- Solar thermal testing facility in one of the countries

The ECOWAS GENERATION AND TRANSMISSION MASTER PLAN

The ECOWAS Renewable Energy Policy highlights renewable energy scenario that is fully complementary to the ECOWAS power supply strategy and conventional national supplies, both as a significant contribution to bulk power generation and as a prevailing contribution to universal energy access for rural areas. Projects to be developed under the renewable energy power generation are to be implemented by ECREEE.

The ECOWAS Generation and Transmission Master plan approved in September 2011, foresees 30 power generation projects selected as regional priority power projects with a total capacity of 10.3 GW and a cost of US$18 billion (€15 Billion). The major share of this new generation and transmission capacities is projected to be available from 2017 to 2019. The selected projects are based primarily on large hydro power (21) with 7,093 MW, on natural gas (3) with 1,300 MW, on coal (2) with 1,075 MW and on renewable energy (4) with 800 MW. It must be noted that some projects are already getting delayed, and, therefore, the proposed scenario will most likely not happen as scheduled. This would have serious consequences for the importing countries and countries relying on new large hydro. In this context, RE technologies might assume more competitive roles.

The tables below show the lists of projects (generation and transmission) earmarked for regional implementation or as a regional priority projects:

Table 1: REGIONAL PRIORITY GENERATION PROJECTS

Regional Project	Priority Capacity	Annual Energy Generation	Generation Cost	Year of Project Commissioning
Coal Power plant in	875MW		2532 Million US $	2016

Sendou-(**Senegal)**				
Gouina Hydroelectric Project: Interconnecting Kayes **(Mali)-**Tambacounda **(Senegal)**	140 MW	565 GWh	329 Million $	2017
Wind Farm(**Senegal-the Gambia)**	200 MW		318 Million $	2021
Hydroelectric plants of Boureya (OMVS) – Badoumbé (OMVS) – Balassa (OMVS) and Koukoutamba (OMVS) 1. Badoumbé 2. Balassa 3. Boureya 4. Koukoutamba (**Mali**)	 70 MW 181 MW 160 MW 281 MW	 410 GWh 401 GWh 455 GWh 455 GWh	 197 Million $ 171 Million $ 373 Million $ 404 Million $	 2017-2019 2017-2019 2021 2019-2021
Kaléta Hydro **(Guinea**)	240 MW- 3 x 80 MW	946 GWh	267 Million $	2015
Sambangalou Hydro (**Guinea**)	128 MW- 4 x 32 MW	402 GWh	433 Million $	2017
Digan Hydro (**Guinea**)	93.3 MW	243 GWh	112 Million $	2012
Souapiti Hydro (**Guinea**)	515 MW	2518 GWh	796 Million $	2017-2019
Amaria Hydro(**Guinea**)	300MW	1435 GWh	377 Million $	2019-2021
Grand Kinkon Hydro (**Guinea**)	291MW	720 GWh	298 Million $	2012
Kassa Hydro **(Guinea/Sierra Leone)**	135 MW	528 GWh	214 Million $	2019-2021

Mount Coffee Hydro (**Liberia**)	66 MW	435GWh	383 Million $	2015
Bumbuna Hydro(**Sierra Leone**)	400 MW – 1560GWh – 520 M$	1560 GWh	520 Million $	2017-2019
Félou Hydro **(Mali)**	60 MW	350GWh	170 Million $	2013
Solar project 150 MW **(Mali)**	150MW - 549 M$		549 Million $	2019-2021
Tiboto Hydro **(Cote d'Ivoire)**	225 MW	912 GWh	578 Million $	2021
Fomi Hydro ((**Guinea)**	90 MW	374 GWh	156 Million $	2017-2029
Soubré Hydro **(Côte d'Ivoire)**	270MW	1120 GWh	620 Million $	
Aboadze- combined cycle Thermal Plant (Ghana)	400 MW		356 Million $	2014
Hydro **Adjaralla (Togo)**	147 MW	366 GWh	333 Million $	2017
Project of combined cycle Thermal (**Togo)**	450 MW		401 Million $	2021
Project of thermal plant in Maria Gleta **(Benin)**	450 MW		401 Million $	2014
Solar project 150 MW **(Burkina Faso)**	150MW		549 Million $	2017-2019
Mambilla Hydro **(Nigeria)**	2600MW	11214 GWh	4000 Million $	2019-2021
Zungeru Hydro **(Nigeria)**	700 MW	3019 GWh	1077 Million $	2017-2019
Wind Farm 300 MW **(Nigeria)**	300 MW		477 Million $	2021
Coal plant of Salkadamna **(Niger)**	200 MW		573 Million $	

Table 2: REGIONAL PRIORITY TRANSMISSION AND INTERCONNECTION PROJECTS

Project	Length of Transmission line	Cost of project	Commissioning Year
Hydroelectric plant Gouina: 225 kV OMVG loop	280 km	65 Million $	2019
225kV OM VG double circuit loop Linsan (Guinea) -Manantali **(Mali**) Reinforcement of Manantali-Bamako-Sikasso (**Mali**) section		131 Million $ 151 Million $	1st circuit: 2017-2019; 2nd circuit: 2019-2021
225kV OM VG loop Bolgatanga (**Ghana**) – Bobo Diolasso (**Burkina**)- Bamako (**Mali**)	742 Km	230 Million $	2015
225 kV OMVG loop between Senegal, The Gambia, Guinea-Bissau.	1677 Km	576.5 Million $	2017

Grand Kinkon western section of OMVG loop		141 Million $	2012
CLSG 225kV OMVG double circuit loop.	1060 km	430 Million $	2015
Second circuit of CLSG line 225kV OMVG loop	1060	69 Million $	2017-2019
225kV OMVG loop Ségou (**Mali**) - Ferkessédougou (**Ivory Coast**)	370 km	175 Million $	2012
225kV OMVG loop Buchanan (**Libéria**) –San Pedro (**Ivory Coast**)	400 km	100 Million $	2019-2021
225kV OMVG loop Linsan-Fomi – Fomi-Nzerekoré – Fomi-Bamako	1350 km	550 Million $	2017-2029
225kV OMVG double circuit loop Fomi (**Guinea**) – Boundiali (**Ivory Coast**)	380 km	111 Million $	2019-2021
225kV OMVG loop Soubré-Taabo (**Ivory Coast**)	196 km	69 Million $	2017-2019
225kV OMVG loop Bolgatanga (**Ghana**) – Ouagadougou (**Burkina Faso**)	206 km	74 Million $	2013
330kV OMVG loop between **Prestea** and **Bolgatanga** (**Ghana)**	640 km	240 Million $	2017-2019
330 kV OMVG loop Niamey (**Niger**) - Birnin Kebbi (**Nigeria**) - Malanville (**Benin**) – Ouagadougou (**Burkina Faso**)	832 km	540 Million $	2017-2019
760 kV OMVG loop network through **Nigeria**	2700 km	2000 Million $	2019-2021
Median Backbone 330kV OMVG loop	713 km	238 Million $	2019-2021
330 kV OMVG double circuit loop Sakete (**Benin**) -	120 km	39 Million $	2021

Omotosho (**Nigeria**)			
225kV OMVG loop Salkadamna-Niamey (**Niger**)	190 km	72 Million $	2019-2021

ECOWAS-ACTION PLAN IMPLEMENTATION STRATEGIES AND STATUS

Regional Priority Projects planned for implementation **2011 – 2025:**

- **10 000 MW** to be installed of which **7 000 MW** will be hydro sources
- **16 000 km** of transmission lines

TOTAL INVESTMENT COST is **US$ 24 BILLION** with GENERATION COST of **US$ 18 BILLION** AND TRANSMISSION of **US$6BN**

Table 3: Status of implementation of ECOWAS transmission projects

Project	Status of implementation	Time of Commissioning
330 kV Riviera (Cote d'Ivoire) – Prestea (Ghana)	Projects on-going	Expected commissioning 2015
330 kV Aboadze (Ghana) – Volta (Ghana)	Operational since 2010	Completed
330 kV Volta (Ghana) – Lome "C" (Togo) – Sakete (Benin)	Under-implementation	Completed
330 kV PHCN/TCN **(Nigeria)**	At level of preparation	Expected to be completed 2017
330 kV ABOADZE – PRESTEA – KUMASI –BOLGATANGA , Tumu – Han – Wa	At level of pre-investment	Expected to be completed 2015
Han (Ghana) – Bobo Dioulasso (Burkina Faso) –Sikasso (Mali)– Bamako (Mali)	Pre-investment	Expected to be completed 2015
225 kV Nzerekore (Guinea) - Fomi (Guinea) – Bamako (Mali)	Pre-investment	To be completed 2016
330 kV Birnin Kebbi (Nigeria) - Bemberke (Benin) – Niamey (Niger) Ouagadougou (Burkina Faso)	Pre-investment	To be completed 2017
147 MW WAPP Adjarala Hydropower Facility	Pre-investment	To be completed 2017
60 MW Felou Hydropower Project	At level of implementation	To be completed 2014

a. INTER-ZONAL TRANSMISSION HUB SUB-PROGRAM

(Burkina Faso, OMVS via Mali, Cote d'Ivoire via Mali, CLSG via Cote d'Ivoire).

The main transmission hub sub-programmes for the region include:

- 225 kV Bobo Dioulasso (Burkina Faso) – Ouagadougou (Burkina Faso);
- 225 kV Bolgatanga (Ghana) – Ouagadougou (Burkina Faso);
- 225 kV Cote d'Ivoire – Mali;
- 330 kV Aboadze (Ghana) – Prestea (Ghana) – Kumasi (Ghana) – Bolgatanga (Ghana) + Tumu (Ghana) – Han (Ghana) – Wa (Ghana);
- Han (Ghana) – Bobo Dioulasso (Burkina Faso) – Sikasso (Mali) – Bamako (Mali);
- 225 kV Fomi (Guinea) – Bamako (Mali) – Nzerekore (Guinea) – Linsan (Guinea)
- 147 MW WAPP Adjarala Hydro Power Facility

Both the generation and transmission projects identified under the ECOWAS Generation and Transmission Master Plan have been spread between phases 1, 2 and 3 according to:

The implementation of this master plan has been scheduled to ensure the load supply throughout the region. This will be implemented in line with following phases of development:

- **Phase 1: Commissioning in the period 2017-2019**
- **Phase 2: Commissioning between 2019 and 2021**
- **Phase 3: Commissioning at long-term (2021-2023)**

THE WEST AFRICA GAS PIPELINE (WAGP)

The West African Gas Pipeline project is an International Gas transmission system that will transport clean, reliable and cheap natural gas from Nigeria to customers in Benin, Togo and Ghana. The proposal for a natural Gas Pipeline across West Africa was made in 1982 by the ECOWAS Commission ECOWAS as a key regional economic goal. The World Bank undertook a study on this in 1992 which confirmed the viability of a Natural Gas Pipeline based on ample reserves of Nigerian Natural Gas and Regional Energy needs. The plan calls for Chevron and its partners to build a 620-mile offshore line capable of initially shipping 180 million cubic feet of Nigerian gas per day for sale to power plants and other major gas users in Ghana, Togo and Benin.

The main objectives of the gas pipeline master plan were three folds:

- To encourage Royal Dutch Shell and Chevron to tap into a vast resource that since the onset of oil production in the 1960s has been wasted in the associated gas burning-off process known as flaring.
- To provide a cheap source of energy in a region starved of electricity, by serving as International Gas Transmission System that will transport clean, reliable and cheap natural gas from Nigeria to customers in Benin, Togo and Ghana.
- Foster regional economic and political integration that would support economic growth, and in particular the development of the West Africa electricity market.

1.1 Agreement on project

In 2000, the four nations involved signed an InterGovernmental Agreement for a harmonized fiscal and regulatory framework for cross-border construction and operation of the gas pipeline. The four Nations and the West African Pipeline Company (WAPCo) signed International Project Agreement (IPA) for the development of the pipeline in 2003. Construction of the WAGP therefore began in 2005 and by 2008, the Pipeline construction had completed and gas introduced into pipeline.

1.2 The Project benefit

The project is the sub-region's solution to bringing energy for economic growth and environmental benefits to Ghana, Togo, Benin and Nigeria. To help in the energy access challenges in the sub-region, the WAGP aims to achieve the following benefits:

- provide a long-term supply of abundant, clean, relatively cheaper fuel from Nigeria to Ghana, Togo and Benin;
- transfer technical knowledge and skills to relevant public agencies, local consultants, contractors and their employees across the four countries
- Employ over 100 skilled people from the sub-region, on competitive selection basis. This number has been far greater during construction
- provide a new level of regional co-operation and economic integration to enhance regional stability under the auspices of ECOWAS

- serve as a catalyst for direct foreign investment in the project countries
- Provide Nigerian producers with benefit from additional revenues accruing from the sale of associated gas to WAPCo
- To provide each of the four countries with some direct tax benefits
- Provide the three gas recipient countries with some fuel gains
- Enhance the regional environment by substituting natural gas for less desirable fuels. It will also lead to reduction in gas flaring in Nigeria, reduction in greenhouse gas emissions, and serve as a springboard in the efforts against deforestation.

1.3 Status of Project implementation

The initial phase of the project implementation was completed in 2008 linking mainly an off-shore pipeline from Alagbado (Nigeria) to Takoradi (Ghana). Commissioning of the pipeline began in late Nov 2008. Gas introduced into the offshore pipeline on Dec 6, 2008 from Nigeria to Takoradi. Commissioning successfully completed on Dec 14, 2008. Construction of the Takoradi Regulating and Metering Station has been completed.

1.4 The future prospects

The project has the prospect of being extended from Takoradi in Ghana to Senegal. This will mainly be an off-shore development project and will augment the electricity and generation and distribution projects earmarked for the region in the Master Plan.