

Ministry of Energy



The Future of Renewable Energy in Ghana: The Master Plan

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-Ministry of Power- RAED

WHAT IS RENEWABLE ENERGY?

- Renewable Energy is basically defined as energy derived from resources that are naturally replenished within the human timescale.
- Energy from these resources are mostly carbon neutral: they contribute very little or No Greenhouse Gas Emissions.
- Ghana's known renewable energy resources includes hydropower, solar, wind and biomass energy.

- Ghana and some African countries for a long time did not consider Large Hydro Power as Renewables.
- Developed nations that are major greenhouse gas emitters all accounts for their hydropower plant as part of their renewable portfolio
- AU meeting of Energy Ministers in Lome Togo agreed that African countries consider their large hydro plants as part of their renewable energy portfolio.

RE-THINKING RENEWABLE ENERGY

- What Priority Areas Can Renewable Energy Development Support
- What policies are (need to be) in place for the development and promotion of the RE technologies
- Strategies and Targets for Renewable Energy Development
- What are the financial implications for achieving the said targets?
- How can be they be funded?
- Progress to Date.

- **THE RENEWABLE ENERGY MASTER PLAN**

Renewable Energy Master Plan (REMP)

- Renewable Energy Master Plan is being developed with the goal to provide investment-focussed framework for the promotion and development of the country's rich renewable energy resources for sustainable economic growth, and contribute to improved social life and reduction of adverse climate change effects.
- REMP is being funded by the Government of Denmark under the Ghana-China UNDP Renewable Energy Technology Transfer Project
- The main implementing Agency is the Energy Commission

REMP Development Process

- The development of the REMP took into consideration existing policies, strategies and resource potentials and prescribed targets and actions required for each of the renewable energy technologies.
- The broad strategies proposed for the successful implementation of the REMP include the following::
 - Boost and sustain local assembly and manufacture of RETs through a systematic phasing out of import duty exemptions on RETs where the country has a competitive advantage;
 - Strategically recommend for consideration tax exemptions on components and materials for assembly and manufacture to make RETs competitive on the local and sub-regional markets;
 - Provide support to existing RET assembling/manufacturing companies including preferential procurements under public financed projects;

Other Proposed Strategies

- Guarantee local market through local content and participation;
- Institutionalise competitive procurement to achieve cost reduction in tariff for utility scale renewable energy projects;
- Continuously provide investment support for the upgrading of the National Interconnected Transmission System to accommodate the planned renewable energy power targets;
- Develop legislation to ensure that increased development of renewable energy projects does not become detrimental to the environment;
- Intensify awareness creation;
- Build capacity in various aspects of renewable energy development; and
- Support research and development.

Implementation plan

- The REMP is proposed to be implemented in three (3) cycles
 - First cycle (or transition phase) running from 2018 to 2020.
 - Second cycle will run from 2021 to 2025 and
 - Third Cycle will run 2026 to 2030 respectively (see Table E1).
- Each cycle will be reviewed in the last year of implementation and the outcome used to improve the implementation of the next cycle.

RENEWABLE ENERGY TARGETS

RE Technology	2015	2020	2025	2030
Large Hydro	1,404.0	1,404.0	1,404.0	1,404.0
Small Hydro	-	-	315.0	608.0
Waste-to-energy	-	10.0	10.0	10.0
Biomass	-	97.0	305.0	555.0
LFGTE	-	0.2	0.2	0.2
Biogas	-	-	30.0	30.0
Wave	-	15.0	25.0	114.8
Wind	-	150.0	400.0	650.0
Solar PV	22.5	243.0	615.0	1,072.5
Total (Incl. L Hydro)	1,426.5	1,919.1	3,104.1	4,444.4
Total (Exc. L Hydro)	22.5	515.1	1,700.1	3,040.4

Targets for Solar Technologies

TECHNOLOGY / INTERVENTION	UNIT	REFERENCE (2015)	2020	2025	2030
Solar Water Heaters	Units	4700	20,000	70,000	135,000
Solar Lanterns	Units	72,000	200,000	1,000,000	2,000,000
Utility scale Solar	MW	22.5	200	600	1000
Solar Crop Dryers	Units	<40	75	200	350
Rooftop/net metering Solar PV	MW	1.7	20	120	200
Standalone Solar PV Systems	MW	2.5	2	8	14
Street/Community lighting	MW	5	7	11	25
Solar Traffic Lights	%	-	10	30	60
Solar Irrigation/water supply	Units	<30	100	300	500

Targets for Wind and Hydro Technologies

TECHNOLOGY INTERVENTION /	UNITS	REFERENCE (2015)	2020	2025	2030
Wind Irrigation/water pumping	Units	<20	35	65	100
Standalone systems (including net-metered)	MW	<0.1	0.1	1	2
Utility scale	MW	0	275	500	800

TECHNOLOGY INTERVENTION /	UNITS	REFERENCE (2015)	2020	2025	2030
Medium Hydropower	MW	-	100	150	300
Small Hydropower	MW	-	1	4	10

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Renewable Energy Masterplan for Ghana

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Targets for Biomass /Waste-to-Energy Technologies

TECHNOLOGY / INTERVENTION		UNITS	REFERENCE (2015)	2020	2025	2030
Utility scale Biomass Power	Biomass /Waste to Energy	MW	0.8	87	280	470
	Biogas	Agricultural/ Industrial organic waste	Units	< 20	30	100
Institutional		Units	< 100	180	280	400
Domestic		Units	< 50	80	130	200
Landfill	Municipal Waste	Units	1	3	10	10

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Existing Renewable Energy Policy Frameworks

- Renewable Energy Act 2011 (Act 831)
 - Grid Code for utility scale RE grid interconnection
 - Net metering Code
 - Draft Standardized Power Purchase Agreement (PPA)
 - Guidelines on Renewable Energy Purchase Obligation
 - Licensing framework developed
 - Feed-in-Tariff Scheme in place since Oct 2013
- Competitive Bidding option tested for Solar with amazing results
- Ongoing activities
 - Wind resource assessment in 13 potential sites at 60m and 80m height.
 - Biomass resource assessment for power generation.
 - Feasibility studies for three potential hydro sites with total estimated capacity of 200MW

Progress to Date: Utility Scale Renewable Energy

- Investment interest in Renewable Energy particularly for utility scale grid integration is high
 - Three Utility Scale Power Plants currently in operation
 - 2.5MW VRA Solar at Navorongo
 - 20MW BXC Solar farm at Onyadzi (near Winneba)
 - 100KW Safisana Waste-to-Energy Power Plant at Ashiaman.



Ghana's largest Solar farm - 20MW
Near Winneba Central Region



ONGOING IPP INITIATIVES IN ADVANCED STAGE

Eighteen (18) PPAs with a total capacity of 910.5MW have already been signed or initialized with ECG as the main off-taker.

RE Resource	Quantity	Total Capacity (MW)
Solar	13	620
Wind	2	200
Biomass	1	80
Wave Energy	2	10.5

Seven (7) ongoing GoG initiatives with total capacity of 440MW

RE Resource	Quantity	Total Capacity (MW)
Solar	3	82
Wind	1	150
Hydro	3	208

Eleven (11) IPPs with a total capacity of 431MW have reached the stage of negotiation for PPA with ECG. These includes Solar -3 (40MW), WtE – 6 (299MW), Hydro 1 (42MW) and Wind 1 (50MW)

***Gazetted Feed-In-Tariffs Effective 1st October, 2016

Renewable Energy Technology	F-I-T (GHP/kWh)*	US Cents/kWh
Wind	65.3529	16.5551
Solar	59.775	15.1421
Hydro<=10MW	52.9428	13.4114
Hydro (<=10MW and <=100MW)	56.5312	14.3204
Tidal Wave (Ocean Wave)	52.9428	13.4114
Run-Off-River	52.9428	13.4114
Biomass	69.1225	17.5100
Biomass (Enhanced Technology)	72.8589	18.4565
Biomass (Plantation as feedstock)	78.1092	19.7865
Landfill Gas	69.1225	17.5100
Sewage Gas	69.1225	17.5100
Geoplutonic (Geothermal)	46.5817	11.8000

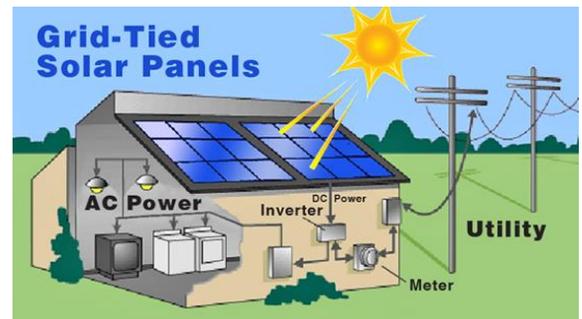
* The rates are denominated in Ghana Pesewas

* The approved rates are based on Ghana Cedi/US Dollar Exchange Rate of G¢3.9476 to US\$1.0000

- MoEn in 2016 facilitated tendering process for 20MW Solar.
- Tariffs of 11.4 USCents/KWh recorded.
- BPA followed with a 50MW solar Tender.
- Tariff of 9.8USc/KWh attained.
- ECG re-negotiate tariffs for all signed PPA downwards to reflect current market offers.

Distributed Renewable Energy Generation

- Target:200,000 Solar Roof Tops (200MWp) by 2030
- Implemented by the Energy Commission.
- 2,010 Application Received out of which 1,474 have been approved to benefit from the capital subsidy
- 355 Completed installation for which invoices have been submitted



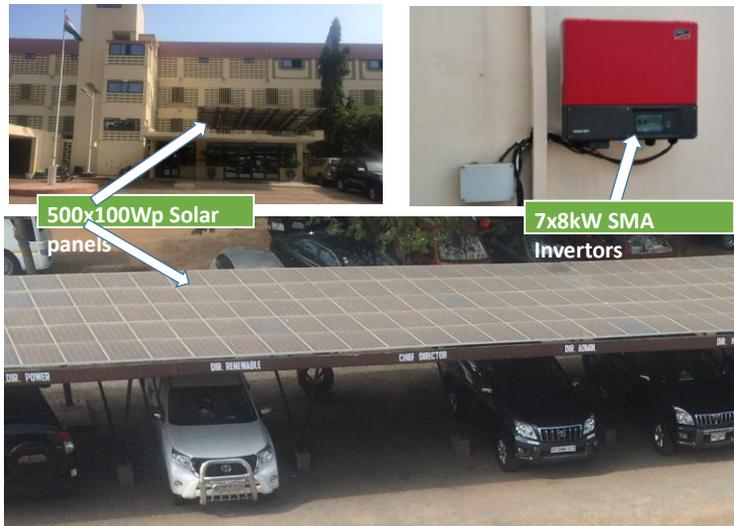
PURC Approved Enduser-Tariff Oct.2016

Residential	GHp	US Cents
0-50 (Exclusion) (GHp/kWh)	33.56	8.50
51-300 (GHp/kWh)	67.33	17.06
301-600 (GHp/kWh)	87.38	22.13
601+ (GHp/kWh)	97.09	24.59
Service Charge (GHp/month)	633.17	160.39
Non-Residential		-
0-300 (GHp/kWh)	96.79	24.52
301-600 (GHp/kWh)	102.99	26.09
601+ (GHp/kWh)	162.51	41.17
Service Charge (GHp/month)	1055.29	267.32

Current Feed-in-Tariff for Solar **GHS 59.77 (UScent 15.14)**
 Index at exchange rate of Ghs3.9476/US\$ (Sept 30, 2016)

P2. Distributed Renewable Energy Generation (DREG)

50KWp Solar Park at the Ghana Ministry of Energy



- System currently account for only 15-20% of consumption.
- Average monthly consumption from ECG **28,480KWh (USD 11,724.30)**
- Average monthly generation from Solar **4,680KWh**
- **Annual contribution from Solar Park – GHs 91,265.64**
USD 23,8119.27
- Investment cost for 50KWp without battery backup
- **USD60,000 -USD70,000**
- Pay Back **(2-3 yrs)**

Mini-Grid RE Electrification Program



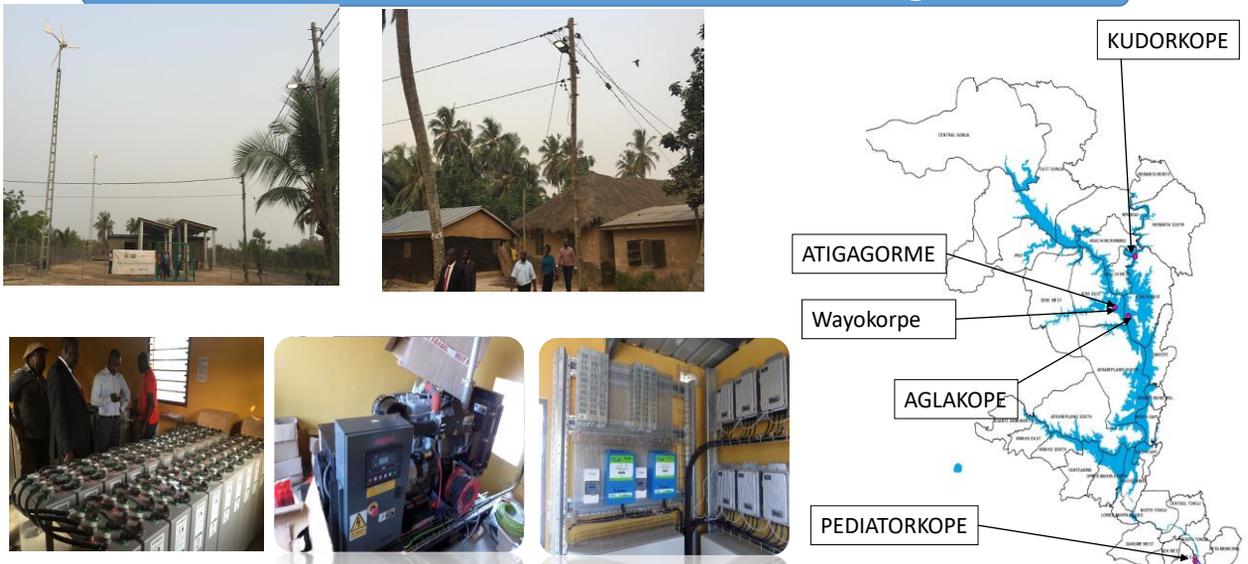
- More than 70% of the population of about 58,000 in the Sene District leave along the lake with no access to electricity.

Objective is to promote mini-grid electricity in remote isolated / island communities with populations above 1000 inhabitants that cannot be immediately connected to grid electricity

Mini-Grid RE Electrification Program

- Policy to mainstream Mini-grids into National Electrification Programme developed and operationalised
 - Public sector led investment with VRA and ECG/NEDCo responsible for generation and distribution respectively.
 - Uniform pricing tariff, zero connection fee for mini grid customers
- Hybrid Mini-grids developed in 5 island communities on the Volta lake to provide electricity services for over 6000 inhabitants.
- Launched socio-economic studies for 3 additional mini-grids under SECO grant financing for Island Communities in the Ada East District.
- Funding secured for additional 55 mini-grids under the SREP/CIF (Scale Up Renewable Energy Program/ Climate Investment Fund)

P3. Mini – Grid RE Electrification Program

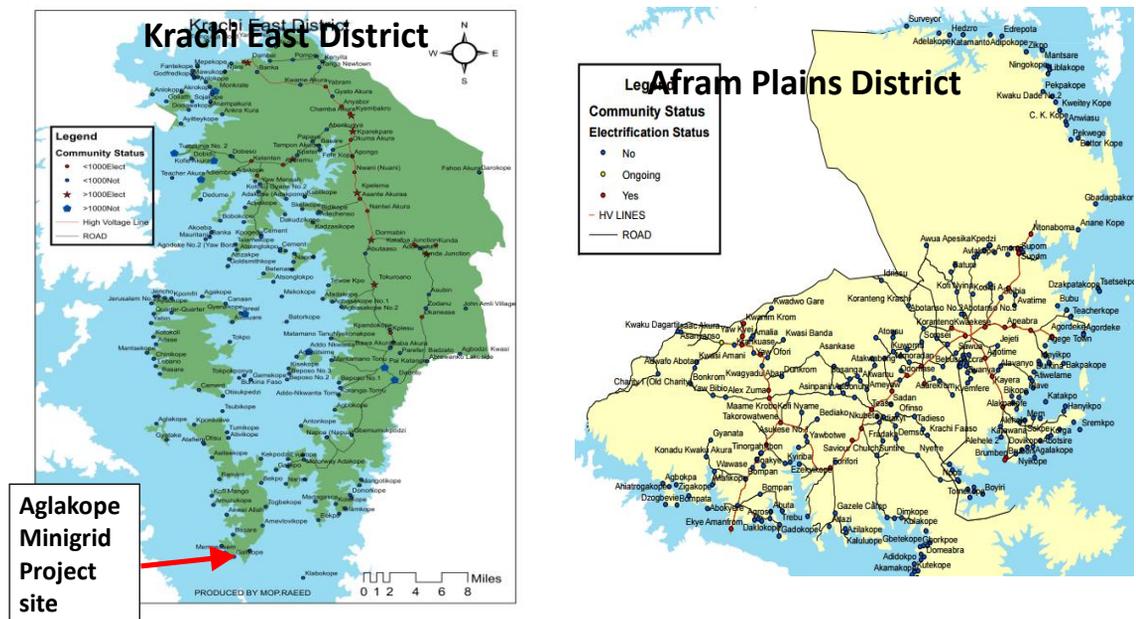


There are over 2,000 communities along the Volta lake in 23 Districts with populations above 1000 inhabitants that are not likely to be immediately connected to national grid.

Highlights of the 4 Pilot Schemes

- 552 residential and non-residential connections
- Smart Metering system with 5 main load categories with tariffs similar to that of the national grid for residential and non-residential.
- LED street/path lighting facility (30 per Community)
- Off peak incentive scheme.

Potential Mini-Grid Communities in Ghana



P4. Stand-alone Off Grid Electrification Program (SOGE)



Off-grid Stand Alone Electrification

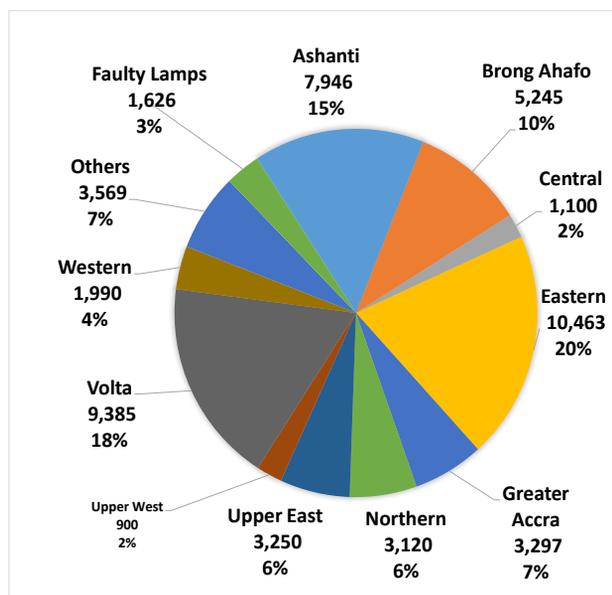
- About 1,500 Solar Streetlights and over 1,400 Solar systems installed in Clinics, security outpost and schools in remote communities for lighting, mobile phone charging and support to ICT education.
- Cocoa Board and Urban Roads are also involved in the installation of solar streetlights across the country. No mechanism currently in place to ensure maintenance and replacement of components.
- The Climate Investment Fund is supporting Ghana to to install 38,000 solar systems for homes, clinics and schools. However access to the fund for implementation is subject to counterpart funding from the Gov. of Ghana.
- **Need for the scope of Streetlight Levy and the Rural Electrification levy to be expanded to cover Off-grid Electrification activities.**

P5. Solar Lantern Promotion Program (SLAPP)

- The goal of this program is to promote the use of solar lanterns as the main source of lighting to replace kerosene lanterns in poor and vulnerable off-grid rural households.
- Remove subsidy on kerosene and redirect resource to disseminate two million (2,000,000) solar lanterns in off-grid rural homes over a period of 8 years (2013-2020).
- First 20,000 units (with phone charging functionality) procured sold out on pilot phase in 2013-2014, and additional 55,000 units of portable solar lanterns procured in 2014 and sold under 70% subsidy to replace kerosene lanterns in remote communities.
- The 3rd phase of another 70,000 units were procured through the Distribution Directorate for distribution.

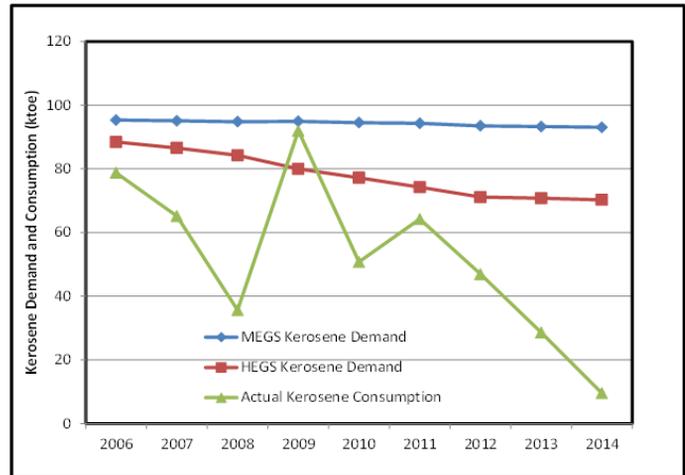
Current Status and Regional Distribution of Solar Lanterns

REGIONAL BREAKDOWN			
ID No	REGION	QTY SUPPLY	%
1	Ashanti	7,946	15
2	Brong Ahafo	5,245	10
3	Central	1,100	2
4	Eastern	10,463	20
5	Greater Accra	3,297	6
6	Northern	3,120	6
7	Upper East	3,250	6
8	Upper West	1,200	2
9	Volta	9,385	18
10	Western	1,990	4
11	Others	3,569	7
12	Faulty Lamps	1,626	3
TOTAL		52,191	100



P5. Kerosene Lantern Replacement Program

- Private sector has taken up the challenge to deploy both solar and battery operated lanterns to power LED lamps.
- Subsidy on Kerosene has been removed and kerosene consumption for lighting has drastically reduced.
- **Need to amend and redirect the Kerosene Distribution improvement Levy for solar Lanterns**



Source: EC SNEP-2015

P6. BioEnergy Programme (BEP)

- Goal is to ensure Sustainable use of bioenergy for cooking and Productive Use.
- Finalize the development of a biofuel policy document aim at creating the policy environment for:
 1. Promoting improved cookstoves for domestic and commercial application
 2. Supporting the development of biomass briquettes, forest/crop residues, biofuel and biogas as alternative energy source for thermal and electricity
 3. Supporting re-afforestation to sustain woodfuel production
 4. Regulating the unsustainable destruction of forest for energy.



ESTIMATED ELECTRICITY COST FROM RE

RESOURCE	CAPITAL COST	FIX O&M (\$/KW-Yr)	ENERGY COST (US\$C/KWh)	FIT -10YR (US\$C/KWh)
Hydro	5,000	45	14.3	14.32
Wind	3,100	46.7	16.3	16.6
Solar	1,420	24.8	11.1	15.1
Biomass	3,700	110.3	16.4	17.55

Source: IRRP (USAID/ICF) April 2017

Economic and social impacts



Financing Strategy

- Public Private Partnership Arrangements
- Multilateral & Bilateral Sources from Development Partners
- Public Sector – Budgets & Concessional Loan Facilities
- National Electrification Levy (electricity consumers)
- Renewable Energy Fund
- Internally Generated Funds

Conclusion

- Government is committed to increase the contribution of Renewable Energy by 10% by the year 2020
- Government is also determined to achieve the SE4All target of doubling the use of renewable energy by 2030.
- Significant financial investment is required
- A robust grid network and a cheap base generation plant other than Akosombo is required
- The role of the Development Partners and the Private Sector are key.
- The Ministry of Power will welcome your support in the implementation of the Mini-grid Policy.
- Acknowledge the immense support of the Development partners such as the WB-GEDAP, Spain, SECO, AfDB, USAID, JICA, China, Denmark, USAID, Germany among others.

THANK YOU

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