Investigation of Ghana Electrification, Renewable Energy Development, Policy Research and Market Analysis

Transition from piloting policy and tech demonstration to Market adoption

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Background of the report

Under UNDP's South-South Cooperation and UN's Sustainable Energy for All (SE4ALL) initiative, UNDP China has been funded to develop a project between China and Ghana, aim to promote the transfer of renewable energy technologies as well as strategy/schemes for renewable energy scale-up, from China to Africa. The planned support will not only transfer hardware, but focus on the institutional framework and capacity required to make the local absorption of renewable energy technologies and business model more effective.

The present project is collaboration between the Energy Commission in Ghana, the Ministry of Science and Technology in China and the UNDP Country Offices in Accra and China. The project will facilitate exchange of expertise and technology between China and Ghana, thereby building on China's unique development experience. Addressing Ghana's need to increase universal energy access, the project aims to effect off-grid community-based electrification, increase the share of renewable energy and promote the productive uses of energy. The project will not only set-up schemes in Ghana for absorbing new technology, but also help the country creating enabling environment for private sector 's participation on RE technology scale-up with proper business models. In addition, the project will promotes the production of renewable energy technologies in Ghana. Ghana's Energy Commission and China's Ministry of Science and Technology will implement the project. UNDP China and Ghana will provide technical and administrative support for the project implementation.

In the past decades, China has achieved great success on RE development, both on utilization and production. However due to the different social and governmental management schemes, different banking system, different land management policies etc..China's RE development model may not perfectly suitable for other developing countries, while RE technology adaptation still need careful testing. In this report, the author will

1) Report of a comprehensive understanding of Ghana's policy and market context
2) Report on analysis of China's experience on rural electrification and recommendations for good practice for Ghana's context
3)List of Renewable Energy Technologies for transfer from China to Ghana
4)Briefing paper on technology selection and transfer approaches from China to Ghana for Chinese stakeholders
5) review the current situation regarding to Ghana Renewable energy development, analyze barriers for scale-up of on-grid and off-grid RE technology, and provide advices on removing the barriers.

In addition, the author will also provide suggestion on project activities that could help further removing RE development barriers. The report has been prepared based on existing research on Ghana's RE sector, the author's interview with various experts in Ghana's RE sector, as well as the findings from several stakeholder meetings in both Ghana and China. The report could serve as an inception report for the UNDP project.

I Ghana’s Renewable Energy (RE) policy and market

1.1Country’s economics and energy sector Overview

1.1.1 Country’s economic overview

Ghana occupies an area of 239,000 sq km and has a population of 24.9 million (Human Development Report, 2011 estimate), with a relatively high annual growth rate of 2.4% compared to 1.6% for other lower-middle income countries, but in line with the 2.5% average for Sub-Saharan Africa. Ghana's has one of the highest GDP per capita in West Africa. The country has a diverse and rich resource base with gold, timber, cocoa, diamond, bauxite, and manganese being the most important source of foreign trade. In 2007, an oilfield which may contain up to 3 billion barrels of light oil was discovered. Yet, in spite of abundance of natural resources, a quarter of the population lives below the poverty line. This page provides the latest reported value for - Ghana GDP Growth Rate - plus previous releases, historical high and low, short-term forecast and long-term prediction, economic calendar, survey consensus and news.

The First Medium-Term Development Plan (1997-2000) based on Vision 2020 focused on the following priority areas: Human Development, Economic Growth, Rural Development, Urban Development, Infrastructure Development, and an Enabling Environment. The country’s development goal concentrate on the following themes: Production and Gainful Employment, Human Resource Development and Basic Services, Special Programmes for the Poor and Vulnerable, and Governance. Across these themes, five areas were selected for priority action: Infrastructure, Rural Development based on Modernized Agriculture, Enhanced Social Services, Good Governance, and Private Sector Development.

Unlike in China that large portion of energy consumed by industry, the services sector still remains the backbone of the economy, accounting for about 48.5% of goods and services produced in 2011, followed by industry with 25.9%, and agriculture with 25. 6%. In terms of growth, industry recorded the highest, with 41.1%, with services coming in second with 8.3%. Agriculture had the lowest growth of 0 .8%. Mining and quarrying helped push industry’s growth with 206%. All the sub-sectors under services recorded some significant growth; however agriculture performed badly, with the exception of cocoa, which went up by 14%. The performance of agriculture could be further improved by introducing modern agriculture development model which need intensive capacity building and hardware inputs, including energy supply.

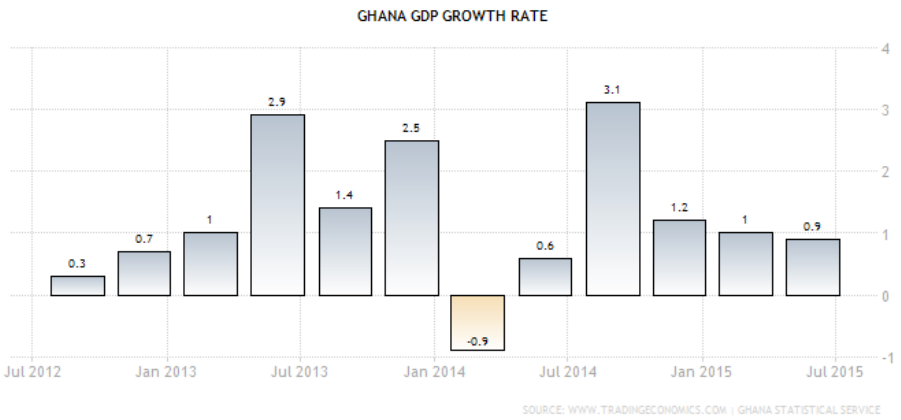


Figure 1.1 Ghana's GDP Growth Rate October , 2015.

Ghanaian annual inflation rate accelerated for the thirteenth consecutive month to 16.5 percent in September of 2014 from 15.9 percent in the previous month. It is the highest rate since November of 2009, driven by a jump in housing, water, electricity, gas and other fuels cost. On a Year-on-year basis, cost of housing, water, electricity, gas and other fuels recorded the highest increase (63.5 percent), followed by transport prices (27.1 percent). In contrast, education recorded the lowest increase (3.5 percent). Food prices rose 5.8 percent.

On one hand, such inflation emphasize the importance of stable and affordable energy supply to the economic development, on the other hand, it also point out the potential risk for the investment in energy sector, no matter on-grid or off-grid.

1.1.2 Ghana 's energy resource and market

Ghana is relatively well endowed with a variety of energy resources including oil, biomass, hydrocarbons, hydropower, solar and wind. It also has the capacity to produce modern biofuels. The vision of the energy sector is to develop an "Energy Economy" to secure a reliable supply of high quality energy services for all sectors of the Ghanaian economy and also to become a major exporter of oil and power by 2012 and 2015 respectively (Energy Commission, 2010a).

The major thematic areas that relate most directly to energy access are: i) accelerated agricultural modernization and natural resource management; ii) oil and gas development; and infrastructure, energy and human settlements development. The key areas of policy focus in the medium to long-term for the oil and gas sub-sector are: employment creation; protecting the environment; revenue management and transparency; diversification of the economy; capacity development; and increasing access to petroleum products. To achieve this would require employment-intensive growth strategies that deliver widespread poverty reduction, as well as enabling environment including proper business models together with infrastructure conditions, i.e. road and electricity.

In 2014, the total electricity made available for gross transmission was 13,071 GWh as against

12,927 GWh in 2013; 144 GWh more than last year. The net grid electricity transmitted to the country was 12,906 GWh as against 12,823 GWh in 2013; less than one percent more but 12-16% less than the projected requirement and equivalent to 400-500 MW shortfall. Peak load for the supply to Ghana on the transmission grid2 was 1,970 Megawatts (MW); roughly 10% more than in 2013 and the total (maximum) peak on the transmission grid3 was 2,061 MW; about 6% more than in 2013.

The corresponding Ghana's peak demand (including suppressed demand) and total transmission system peak would be between 1,980-2,300 MW. The grid electricity available for supply in 2015 based on the planned expansion of generation capacity would be 15,000-15,200 GWh. Governmental resource indicates that on the average, the country is losing production worth about US$ 2.1 million per day (or, US$ 55.8 million per month) just being caused by the power crisis alone and that the country lost about US$680 million in 2014 translating into about 2% of GDP due to the power crisis. It further indicated that firms that do not have access to sufficient electricity have lower output/sales, and that not having sufficient electricity lowers firm's annual sales by about 37-48%.

For future, the electricity demand is predicted to exceed 5,000MW by 2016, primarily as a result of the Ministry of Energy's objective of becoming a major exporter of electricity into the West Africa Power Pool, coupled with an increase in demand domestically, as the government seeks to increase the electrification rate to 80 per cent by 2016. This is further fuelled by a high annual GDP growth rate (14.4 per cent in 2011). The Government recognises the importance of IPPs to the achievement of these international and domestic expansion objectives.

1.2 Ghana's Renewable Energy Market

1.2.1 Overview of the renewable energy sector of Ghana

The Ghana's policy commitment towards renewable energy has been translated into actions to support renewable energy development, especially for on-grid RE. The Ministry of Power is working with the Public Utility Regulatory Commission (PURC) and the Energy Commission to develop the regulatory framework for mini-grids and stand-alone electrification interventions. By middle of 2015, provisional licenses issued for Renewable Energy electricity had risen to 62 with capacity totaling 5,074 MW compared with 36 totaling 3,905 MW in 2013. . Out of this 44 are for Solar photovoltaic (PV) generation with a total capacity of 2,472 MW. Last year was 29 with total capacity of 2,155 MW. Private and public sector support for renewable energy is emerging, however much of it is at an early stage of development or implementation.

In middle of 2015, the Climate Investment Funds (CIF) unanimously endorsed Ghana's ambitious investment plan to transform and promote its renewable energy sector. The plan, which is slated

to receive 40 million USD in funding from the CIF's Program for Scaling Up Renewable Energy in Low Income Countries (SREP), is structured around four key projects: renewable energy mini-grids and stand-alone solar PV systems; solar PV-based net metering with storage; utility-scale solar PV/wind power generation; and a technical assistance project (supported by the Sustainable Energy Fund for Africa – SEFA). The infusion of SREP funding, along with 53.5 million USD in support from the African Development Bank (AfDB) and financing from other development partners, will help the country scale up and leverage private and public financial resources to build the country's renewables sector and carry out the innovative set of projects.

Solar photovoltaics.

Solar radiation and sunshine duration data have been collected by the Ghana Meteorological Services Agency for over 50 years. The daily irradiation data has a probable error of 15%. The monthly average solar irradiation in different parts of the country ranges between 4.4 and 5.6kWh/m2 /day (16-20 MJ/m /day).

The Energy Commission has issued licenses and permits to thirty (30) utility-scale solar projects with a total capacity of 1,835 MW and a construction permit to a 20 MW project which is under construction. Pending success of the aforementioned initiatives, the country's solar capacity would reach about 60% of today's peak demand. Solar utilization include: Solar Home System for basic house lighting, radio and TV operation; Solar Hospital System for vaccine refrigeration and lighting; Solar School System for classroom lighting and television for distance education; Solar Streetlight System for lighting general meeting points, such as markets, lorry stations, water supply points and important busy paths/roads requiring visibility; Solar Water Pumping System for the provision of water and irrigation; Solar Battery Charging System for charging automotive batteries for operating TV and radios in rural communities; Solar System for communication and centralized solar system for providing AC power into the grid; and Solar Water Heating Systems.

Wind.

Ghana has rich wind resources near the border with Togo and there is approximately 413 km sq area which could support just over 2,000 MW of wind power, and if moderate wind resources were included, that could go up to 5,640 MW. In mean time wind resource assessments are ongoing at 15 sites with a potential of about 1100 MW power generation. For on-grid wind, there are already private sector company doing feasibility study for development.

In addition, KW level small scale wind projects has also good potential for local economic activities, and some demonstrations already exist which shows steady and good performance.

Small hydropower.

Ghana has significant hydropower potential, and is already tapping this potential with its Akosombo, Kpong and Bui plants, which provide the majority of electricity in the country. Hydropower potential is estimated to be about 2,420 MW, and in addition to the large-scale Bui plant under construction, Ghana is estimated to have 17 medium and 22 mini/small hydropower sites with most sites exceeding 10 MW. The total capacity is estimated to be at 800 MW. Feasibility studies are ongoing for a total capacity of 800 MW at 19 sites. However most of them has not been further development according to various barriers. Ghana is looking to diversify its power resources, as its reliance on hydroelectricity make it particularly vulnerable to drought. With proper resource mapping, and China-Ghana experience transfer, there is strong potential that some project will move on.

Biomass

Biomass is Ghana's dominant energy resource in terms of its endowment and consumption. Approximately, about 20.8 million hectares of 23.8 million hectare land mass of Ghana is covered with biomass resources. Biomass fuels in Ghana mainly comprise of charcoal, plant residues and wood fuel. Wood fuel is the major form of biomass used as energy source for both domestic and commercial purposes in Ghana; about 90% of rural households depend on wood fuel and other biomass resources for domestic purposes (cooking, and heating, etc). The Ministry Petroleum commissioned a report, entitled, "*Assessment of the Financial Landscape for Biomass Power and Minigrids in Ghana*" that revealed that there are numerous clustered agro and wood processing sites generating a large amount of biomass waste. A local biomass energy developer has now acquired environmental and siting clearance permits for a 6 MW biomass power project. Municipalities also generate large quantities of waste which could be used.

Direct woodfuels have a total stock of about 832 million tonnes. Timber logging utilise 2.0 - 2.7 million m3 per annum, generating 1.0-1.4 million m3 of logging residues on an annual basis. These residues include slabs, edgings, off cuttings, sawdust, peeler cores and residues from plywood manufacturing. Sawmill and ply-mill residues are most concentrated in the Kumasi area and large-scale furniture mills are in Accra, with several smaller-scale furniture producers distributed throughout the country. There is also potential of wood residues from construction of roads and skidding trails in the forest for the haulage of harvested timber, wood residues from forest clearings for agriculture and wood from surface mining sites. In addition to logging there are several other potential reserves of biomass. Total land area under tree plantation is estimated at 75,000 ha. Trees of poor form, which will not be suitable for commercial sale, that are removed from these plantations together with the residues from the harvesting of lumber grade trees could also be reckoned as potential sources of energy.
(partially from Energy Commission 2015)

Waste -to-Energy

One realistic and very promising such renewable energy project is that announced by Israeli Blue Sphere corporation in which they will be working with various landfill garbage sites in Accra and Kumasi and converting landfill gas into power. Landfill gas consists about 40-60% of methane, with the remainder being mainly carbon dioxide. Land fill gas (LFG) for power generation has been widely developed in China since 2000, and has a lot of successful applications. In Ghana, this is a high potential sector that Chinese experience could help to solve both energy and environmental problems.

In addition, solid wasteincineration as an option need to be also studied especially for ACCRA area.

Wave and tidal energy.

A Ghanaian company is installing a pilot 14 MW tidal wave power plant at the confluence of the Volta River and the Gulf of Guinea, Ada Foah, in the Greater-Accra Region. However, the project seems will be delayed due to lacking proper business model. A future research may also need to be conducted to see the project could speed-up by China-Ghana cooperation.

1.2.2 Gap and challenge

Based on discussion with other donor agencies and from stakeholder meeting,, we find some of stakeholder's opinion about area of RE development in Ghana include (1) Energy sector still need to reform; (2) Cost of RE still high; (3) business model need to be optimized, while currently consumer's willing to pay is low; (6) The model RE + green production need further exploration; (7) RE technology other than solar and hydro need more attention. (8) Ghana's governmental subsidy on RE need to be more transparent. For all demo project, the team need to have good cooperation with partners, to ensure making some changes for the above 8 points.

Based on the author's observation and opinions from stakeholder meeting, key challenge affecting in particular small and medium size private investors, is the inability to obtain credit or loans to finance their investments in the sector. This is partly due to the fact that the financial sector does not have strong risk mitigating instruments such as partial risk guarantees and renewable energy payment agreements to provide the needed assurance. An important factor in engaging the two sectors is the need to equip the private sector and especially the financial sector with knowledge of the renewable energy industry. This would be crucial in developing and offering the long-term financial products required by the sector.

The macroeconomic factors in Ghana such as inflation, high interest rates and foreign exchange

volatility have largely hindered the ability of local banks to provide long-term financing beyond 3-5 years. Consequently the support of the financial institutions to renewable energy projects has been very poor, and a wide gap exists between available local financing options and the special financing demands of renewable energy projects, such as non-recourse financing, longer tenors and lower interest rates

For off-grid RE, resource mapping will be key important to identify proper technology that can be used in Ghana. For demonstration projects of all types of RE, demonstration will need to be on tech, business model and management schemes. It will also need to show that private sector (both developer and commercial banks) could replicate the demonstration project.

II Ghana Renewable Energy related policy and institution

2.1 Renewable Energy Act

In 2011, Ghana passed the Renewable Energy Act, 2011 (Act 832) to support the development, utilization and efficient management of renewable energy sources. The Act seeks to increase the proportion of renewable energy including solar, wind and biomass in the national energy supply mix and to contribute to the mitigation of climate change. A follow-up Country Action Plan on "Sustainable Energy for All", with emphasis on the promotion of energy efficiency and renewable energy.

The objective of the Renewable Energy Act is to provide for the development, management, utilization, sustainability and adequate supply of renewable energy for the generation of heat and power, and thereby increase the proportion of renewable energy in the national energy supply mix while contributing to the mitigation of climate change (Government of Ghana, 2011).
The four key mechanisms established by the law are: (1) Mandatory purchase policy; (2) Mandatory connection policy; (3) Feed-in tariff system ; (4) Renewable Energy

Broad national strategic areas have been developed further in other national policy documents and strategies, including the National Climate Change Policy (NCCP), the National Climate Change Adaptation Strategy (NCCAS), and the Nationally Appropriate Mitigation Actions (NAMAS).

The process involves activities leading to three key outputs, namely:
 Situation Analysis, with baseline data on sustainable energy access, including an assessment of national initiatives on (1) universal access to electricity; clean fuels and devices for cooking/heating; and mechanical power; (2) improvements in energy efficiency; and (3) increasing the share of renewable energy in the national energy mix; and an analysis of sector strengths and weaknesses in specific areas relevant to the sector such as policy, planning, institutions, finance, monitoring (data and accountability), capacity and partnerships.
 Prioritized commitments and a Country Action Plan (CAP) for Ghana, broadly agreed upon with implementing partners; and Draft Partnership Agreements for implementation of the Country Action Plan.

2.2 Supporting regulatory and policy instruments

Some supporting regulatory and policy instruments are at various stages of development to promote renewable energy development in Ghana, under Renewable Energy Act:

- A National Electricity Grid Code (2009) for renewable energy (being implemented);
- Renewable energy feed-in tariffs (being implemented);

- Guidelines for a renewable energy purchase obligation (under which power distribution utilities and bulk electricity consumers are obliged to purchase a certain percentage of their energy required from electricity generated from renewable energy sources) (draft ready);
- A Renewable Energy Power Purchase Agreement draft template (draft ready);
- A Bioenergy and Policy Strategy which calls for modernization of the supply and use of bioenergy on a sustainable basis (draft ready);
- A framework for the establishment of the Renewable Energy Fund (REF) to provide long-term financing for the promotion, development, sustainable management and utilization of renewable energy resources, especially the extension of electrification access to remote off-grid communities using renewable technologies; and
- An import tax exemption for solar PV system (being implemented).

In accordance with the provisions of the Renewable Energy Act 2011, Act 832, the Public Utility Regulatory Commission set the first Renewable Energy Feed-in Tariffs (RE-FiT) in September 2013 (MOP et al, 2015). The RE-FiT was reviewed less than a year later and gazetted on 1 October 2014. The new RE-FiT is similar to the first RE-FiT but introduces a new guideline for the integration of utility-scale variable renewable energy technologies such as solar PV and wind. The main principles of the new guideline are:

- The total nationwide capacity for solar PV and wind plants without grid stability/ storage systems are limited to 150 MW and 300 MW respectively;
- A maximum of 10 MWp (Megawatts peak) per solar PV plant without grid stability/storage systems is allowed to be connected to the distribution system at any generation site;
- A maximum of 20 MWp per solar PV plant without grid stability/storage systems is allowed to be connected to the national transmission system (161 kV or 330kV) at any generation site.

- Different sources of renewable power (wind vs solar vs landfill gas etc) will receive different Feed-In-Tariffs depending on the respective cost of generating power by different means – and of course the FIT is meant to cover the cost of generation plus a reasonable rate of return for the power producer.

On the other hand , the execution of the Act still need to be further improved. The lack of clarity on the level of the feed-in tariff and the determination of renewable energy procurement targets would appear to somewhat undermine the effectiveness of the Renewable Energy Act in the short term.

2.3 The key players in Ghana's energy sector

The key players in Ghana's energy sector are (partially from Ghana Energy Commission 2015):

- National Institutions;
- Development partners;
- Private sector;
- Non-governmental organizations; and
- Financial sector.

The major national institutions are presented in Figure 2.1.

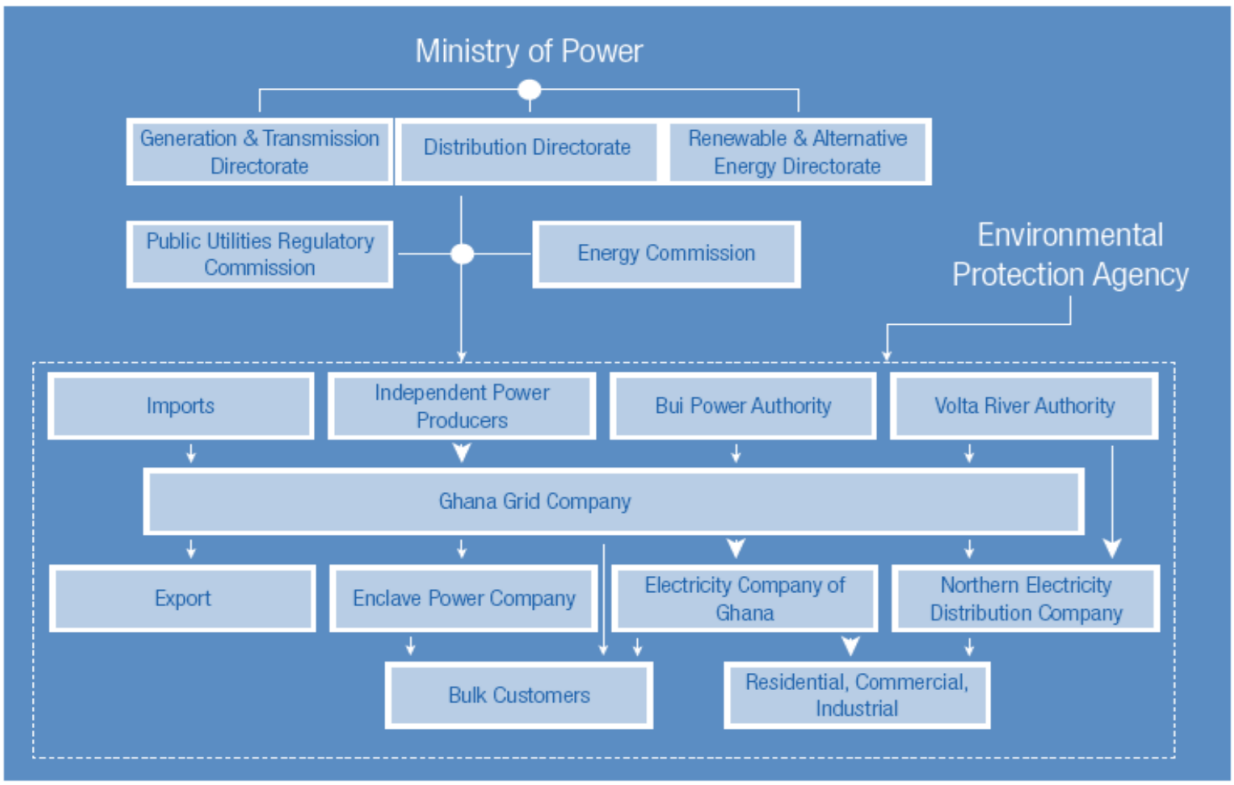
The key institutions mandated to implement the Renewable Energy Act are: i) the Energy Commission; and ii) the Public Utility Regulatory Commission.

The Public Utility Regulatory Commission is mandated to approve rates chargeable for the purchase of electricity from renewable energy by public utilities; Charges for grid connection; and Rates chargeable for wheeling electricity from renewable energy.

Other institutions that should collaborate with the Energy Commission in the development, promotion, management and utilization of renewable energy include:

- Ghana Standards Authority
- Forestry Commission
- Lands Commission
- Environmental Protection Agency
- Ministry of Food and Agriculture
- Metropolitan, Municipal & District Assemblies
- National Petroleum Authority
- Ghana Cocoa Board
- Ministry of Environment, Science, Technology & Innovation
- Any other institution designated by the Minister

A more detail introduction could be found in the Appendix



: Key national institutions in Ghana's energy sector

Source: Ministry of Power, Ghana, 2015

In 1994, the Government of Ghana launched the Power Sector Reforms (PSR) to catalyze the rapid expansion of infrastructure in line with its socio-economic development agenda. The PSR sought to enhance transparency in the regulation of the power sector and to open up the industry to private sector participation by dismantling the vertically integrated utility structure and availing the generation and distribution aspects of the industry to market competition. The implementation of the reform process has resulted in the current unbundled structure with separate operational functions in respect of power generation for the Volta River Authority (VRA), transmission for the Ghana Grid Company (GRIDCo) and distribution for the Electricity Company of Ghana (ECG). As a result of the PSR, the sector has, since 1997, been regulated by the Energy Commission (EC) which is the technical regulator responsible for licensing and advising the Ministry of Energy on policy issues; and the Public Utility Regulatory Commission (PURC) which is the independent economic regulator responsible for approving and setting tariffs. (partially from **Ghana** Energy Commission 2015)

Private sector

Although the efficiency still needs some improvement, the reformed structure is expected to encourage the participation of Independent Power Producers (IPP) in a competitive generation market as well as bi-lateral contracts with bulk customers in a deregulated market (MoP, 2015). As a result of the reform, there is now substantial private sector participation in the sector with a growing portfolio of private sector driven IPPs. The growing renewable energy sector has

attracted a wide range of private sector players, ranging from solar PV distributors and associated investors to agro-industries that use biomass by-products for process-heat generation. Recent private sector entrants include a solar PV assembler and a number of potential wind-farm developers and dedicated energy plantation developers.

In the mean time, private sector RE development participation has not been good enough, due to very high financial cost, poor supportive value chain etc…d It will be also necessary to set up demonstration projects with proper business model with involvement of private sectors including commercial banks , and technical training along the value chain. In addition, business development capacity need to be built for project implementers/managers, service providers and beneficiaries of renewable energy projects.

This situation, together with serious challenges related to the financial solvency of the power sector (the generation, transmission and distribution utilities), is hampering the involvement of the private sector in the renewable energy sector, despite the high level of interest shown both by national and foreign investors.

2.4 Gaps and challenges in institutional level

According to the project documents of this program, there are specific challenges hindering Ghana's progress towards achieving universal access to energy, ensuring a more developed and widespread use of energy for local economic development, especially in the overall regulatory framework:
1) The Government is yet to develop a Renewable Energy Master Plan to design specific actions to put the Renewable Energy Act into implementation.
2) The established Renewable Energy Fund is yet to be resourced and detailed strategies to mobilize the necessary funding are yet to be defined.
3) The Renewable Energy Authority, necessary to form partnerships with private operators for PPP implementations, is yet to be established.

In addition, Inadequate coordination between RE related plans with national development planning, especially for off-grid REs. Inadequate coordination among various energy related agencies. After the reform, there are strong needs for various energy related agencies to work with congress on such important issues. Such lacking of coordination will postpone the set-up of Renewable Energy Fund, which need more quantified reason for the parliament to approve.

What is more, traditional RE technology demonstration centers may not work well for Ghana. Learning from experiences and lessons from the Chinese RE promotion centers, RE promotion centers in Ghana will be needed to deliver outcome/output to cover all barriers in project document to scale up RE (both on-grid and off-grid) in Ghana.

Institutional arrangement need to studied to create enabling environment in a clear way, creating straight forward roadmap to remove those barriers.

III China's Renewable energy Development Route

3.1 From Planning to business and market

In 2006, former President Hu Jintao approved The National Medium- and Long-Term Program for Science and Technology Development (2006-2020), with a particular focus on developing renewable energy industries. Later, in March 2011 the government adopted its Twelfth Five-Year Plan (2011-2015), which focused on seven strategically important spheres: energy-saving and environmental protection, next generation information technology, bio-technology, advanced equipment manufacturing, new energy (solar, wind and biomass power), new materials and new-energy vehicles. The plan calls for non-fossil energy to meet 11.4 percent of China's energy needs by 2015, and 15 percent by 2020. To achieve that, China is to spend $1.7 trillion between 2011-2015, in the form of investment, assistance for state-owned enterprises, and bank loans.

China has already successfully adopted new technologies to consume wind, solar and biomass energy. The Chinese market for wind power began to form in 2003 with the launch of a project by the National Development and Reform Commission (NDRC). A strong, and occasionally controversial, government focus on developing the market meant that by the end of 2012 China was generating 75.32 GW from wind power plants, constituting 27 percent of the global market share. Fourteen provinces produce more than 1 GW annually, including Inner Mongolia, Hebei and Gansu. The government's ambitious plan to reach 200 GW by 2020 looks achievable, provided it can overcome its major challenge: a grid that does not effectively link the major generation centers in the north of the country with the consumption centers in the eastern and southern region. China is placing significant emphasis on developing onshore wind farms, with a goal of generating 5 GW by 2015 and 30 GW by 2030, up from the current 389.6 MW. It also stands to benefit from the jobs created by this effort. According to the China Wind Energy Development Roadmap 2050 prepared by the International Energy Agency and China's own Energy Research Institute, the country will create an additional 260,000 jobs by 2020 in five sectors from turbine manufacturing to maintenance assuming the pace of investment and development continues. By 2050, that figure could be 720,000.

Meanwhile, the rapid growth of solar power in China over the last three years reflects falling production costs and massive state backing. In 2010, the aggregate capacity of China's solar power plants was less than 1 GW. Groundbreaking improvements began in 2011 when China raised the total volume of solar energy to 3.3 GW. According to an estimate of the European Photovoltaic Industry Association (EPIA) estimate, in 2012 China already had photovoltaic capacity of 8.3 GW, in 2013 it was 20.3 GW. Even the most pessimistic EPIA scenario has solar power generating 47 GW for China in 2017, while a more optimistic outlook suggests the figure will be 66 GW. A distinct characteristic of solar energy development in China is the new program of installing solar panels on rooftops (up to 8 GW in 2014), which reduces the costs of grid modernization in the remote regions of Gansu, Xinjiang and Qinghai.

The green energy production in China also involve agriculture sectors: livestock waste, agriculture

and forestry residues, municipal solid waste. China is targeting capacity of 15 GW to 2015 by utilizing waste products, taking into account the country's size, its economy and its vast farmland. This amount would be equivalent to burning 32 million tons of coal. The next two years will be crucial for biomass energy development, with China planning to build and launch 300 power plants to utilize more than 72 tons and 630 tons of agriculture and livestock waste, respectively, and 138 tons of municipal solid waste. With this aggressive policy, China could produce 30 GW of energy from biomass to 2020, giving farmers additional earnings and create new employment. In transport sector, these tremendous investments in alternative energy are to be combined with new vehicle standards and the substitution of coal with gas (LNG).

China's policies on renewable energy development fall into three categories. Similar to the way renewable policies are set in the United States, China's central government establishes the first two levels of policy. Local governments, including provincial, municipal, and county governments, establish the third level of policy with overall direction from the central government.

3.2 Capacity development through international support

During international cooperation started from around 2000, China was trying hard absorbing "Soft" knowledge from international side. International experts and training materials to China has been successfully transformed to local capability in various training centres and RE promotion centers. The trainings were not only at technical level, but also include knowledge about management, policymaking, business model and so on.

Besides the in-house training, practical on-site training (with certification) had also been conducted to allow Chinese engineers and managers could independently operate RE projects.
Chinese experts are also very actively participate the work of International standards on RE sectors. And in future china could also supply or introduce some resources (including human resources and lecture materials) to enhance Ghana's RE sector.

According to China's experiences, all types of renewable energy training should be included in this training centre, not only on research and conceptual teaching, but also should be on engineering, management and financing. As the centre should be a hub and a platform for enabling renewable energy development, it will be even better to organize the centre at a higher level and include more departments such as engineering, public management, business management, and so on…it will also establish a platform to mobilize resource for all kind of RE technologies inside and outside China, set up business model to scale up renewable energy development with sustainability.

Until the recent emergence of labor shortages, China's manufacturing sector has benefited from a growing pool of young workers trained for production jobs in government-run vocational schools. At the start of the reforms in 1980, only 19 percent of senior high school graduates came out of vocational schools. By 2001, however, driven by a policy to emulate Germany's dual-track training system, the proportion of senior high school students graduating from vocational schools was much larger: 45 percent or about 6-7 million vocationally trained graduates each year. This

policy ensured that 90-100 percent of the young workers joining China's factories would be well-trained.

3.3 Investment

The government will have to use a number of different sources, including international climate funds, sovereign wealth funds, micro-financing, as well as ensure China is attractive to institutional investors.

- China is setting up domestic carbon markets and reduce fossil fuel subsidies.
- China also needs to create the right policies and incentives to leverage private finance, such as establishing a national climate fund and a green investment bank and a carbon trading regulatory commission.
- The Chinese government should consider preferential tax rates for cleaner fuels, market mechanisms to promote energy efficiency and make it easier for green bonds to be issued.
- China is also the top producer of solar panels, accounting for about 75% of the world's solar manufacturing.

New funds invested into clean energy gained 16% in 2014 to reach $310 billion. The record is still $318 billion, set in 2011, but there was a significant upward trend last year. Overall, the world added about 100 gigawatts of solar- and wind-power capacity in 2014. China aims to get 15 percent of total energy demand from low-carbon sources by 2020 and cut its carbon intensity by 17 percent from 2011 to 2015 and by 40-45 percent by 2020 versus 2005 levels. These goals will require total investment of up to $333 billion by 2015 and $413 billion by 2020 In 2013, China invested a record $67.7 billion in clean energy - 20 percent more than in 2011. In the mean time both public and private finance will be needed to plug the finance gap but private sector finance will have a larger role to play particularly.

3.4 Chinese RE fund

To address the solvency of the renewable energy fund, in August 2012, the NDRC doubled the electricity surcharge on industrial customers to 0.015 yuan / kWh (0.25 US¢ / kWh), keeping the residential and agriculture surcharge at 0.008 yuan / kWh (0.13 US¢ / kWh) (Chinese announcement). With a little over three-quarters of electricity going to industry, this will increase substantially the contributions to the fund. At the same time, solar FITs were scaled back slightly by instituting a regional three-tier system akin to that developed for wind: sunny but remote areas in the north and northwest offer 0.90-0.95 yuan / kWh (15-15.5 US¢ / kWh) while eastern and southern provinces close to load centers but with lower quality resources offer 1 yuan / kWh (16 US¢ / kWh).

Additionally, distributed solar electricity consumed on-site (which could be anything from rooftops to factories with panels) receive a 0.42 yuan / kWh (6.9 US¢ / kWh) subsidy. Excess electricity sold back on the grid, where grid connections and policy are in place, will be at the prevailing coal tariff, ranging from 0.3-0.5 yuan / kWh (5-8 US¢ / kWh).

3.5 Barriers still exist for Chinese RE sector

However, significant challenges exist for China's renewable energy to grow into a mainstream energy source. First, grid integration is now the single largest bottleneck for renewable power development; solving the grid integration problem will require improved power sector planning, technological upgrades in generation and transmission infrastructure, transformation of power sector operation and dispatch rules, and power market reforms. Second, effective supportive policies and business models, clear and streamlined management procedures, and smart grid technologies have yet to be developed to spur large-scale development of distributed generation. Third, the cost of renewable energy is still high and requires a large amount of public subsidy; stronger incentives are needed to drive down costs through technological advances and economies of scale. Fourth, China so far does not have a clear national strategy to guide renewable energy development. As a result, sectorial policy conflicts and weak policy enforcement are hindering the speed at which renewable energy can replace coal.

IV Technology selection and transfer approaches from China to Ghana

4.1 How China's experience and lessons be applied for RE scale-up

4.1.1 institutional approach

After a research of Ghana's RE policy, market and current development trend, the author found that Ghana has rich renewable energy resources (RERs) like wind, solar PV, mini and small hydro and modern biomass, that can be exploited for electricity production and supply in the country.
For institutional approach, China could share experience and lessons with Ghana on the following field:

1) How to combine RE development with planning: National Medium- and Long-Term Program
It will be important for the country to evaluate the importance of RE quantitatively that how it benefit the economic growth and poverty reduction. China's experience and lesson learned could benefit Ghana's RE Master Plan. The author suggests that more Chinese researcher's could participate the works under Ghana's RE Master Plan.

Institutional arrangement need to studied to create enabling environment in a clear way, creating straight forward roadmap to remove those barriers. For Ghana, it will be also important to integrate RE development in the country's new 5-year development plan as it is very important for economical development in Ghana, and therefore it will be more easily for RE to receive additional support from congress, including budget allocation.

2) How to set-up Renewable Energy Promotion Center for Ghana

Either new or built base on exist facilities, the Center could serves as a platform among regulatory authorities, private sectors, banks, research institutes, and industry professionals, in order to provide a forum to discuss renewable energy development at the national level and subsequently advise the Government on strategic policy formulation.

It can also provide a network for its members from the renewable energy business community without access to communication within their sub-sectors, and provides a platform to voice their concerns collectively. With the support from the China side, the center could acts as a window to bring together national and international project developers and investors (not just Chinese). It promotes technology transfer and raises awareness of renewable energy investment opportunities through an online Investment Opportunity Facility and regional networking and training activities. The RE Promotion Centres will help Ghanan government explore the opportunity for such resources. Types of technology will including solar, Mini-hydro power, and other technologies, that The Chinese partners will provide help based on Chinese experiences.

Research: Situation Analysis, with baseline data on sustainable energy access, including an assessment of national initiatives on (1) universal access to electricity; clean fuels and devices for cooking/heating; and mechanical power; (2) improvements in energy efficiency; and (3) increasing the share of renewable energy in the national energy mix; and an analysis of sector strengths and weaknesses in specific areas relevant to the sector such as policy, planning, institutions, finance, monitoring (data and accountability), capacity and partnerships.

4.1.2 For on-grid RE development

To support on-grid RE development, China could share experience and lessons with Ghana on the following field:

The Renewable Energy Fund has been designed to offer financial support for activities for the promotion, development and utilization of renewable energy such as financial incentives, feed-in-tariffs, capital subsidies, production-based subsidies and equity participation. The lack of clarity on the level of the feed-in tariff and the determination of Ghana's renewable energy procurement targets would appear to somewhat undermine the effectiveness of the Renewable Energy Act in the short term. The fund has currently not yet been set-up, due to many reasons, Chinese experience could provide help.

4.1.3 Off grid RE development Route

Approach or roadmap

(1)Resource mapping: to assess the renewable energy resource potential (various types of RE) in Ghana's off-grid regions, to evaluate the market potential and size for renewable energy systems in these regions; to study the economic activates in different region (or use some existing results or resources from SE4all program).
(2)To develop a comprehensive analytical schemes that can be utilized to evaluate the energy capability and economic viability of off-grid RE technologies in providing electricity services to SME and rural energy consumption facilities;
(3)To characterize rural energy user needs and preferences and, to compare system performance of different stand-alone RE or mini-grid configurations (i.e., bio-gas, PV, wind etc. and hybrid technologies) and competing choices (renewables versus traditional options); to determine the cost-effectiveness of different systems and technology options by calculating system levelized costs to fit local needs.
(4) Prepare feasibility study reports for the identified projects with suitable business model
(5) Cooperation with energy users and introduce financial agencies (local commercial or international banks)
(6) Cooperation with governmental agencies for possible subsidies or support.
(7) Capacity building for all stakeholders using demonstrated technology, business model, and involvement of local work force.

(8) to understand the socio-economic conditions that affect the use of renewable energy options in rural Ghana and develop policy recommendations for the development of Ghana's off-grid renewable energy market.

Productive uses of energy:

Effective and sustained access to energy via RE is key important in improving people's living conditions, and contributes to economic and human development. Energy provides services to meet many basic human needs, particularly heat, mechanical power (e.g. water pumps and transport) and light. Business, industry, commerce and public services such as modern healthcare, education and communication are also highly dependent on access to energy services.

Increasing productive uses of energy is also regarded as a major challenge to be addressed if sustainable demand with pro-poor outcomes is to be generated, and considering that effective access to energy by the poor is often hampered by weak purchasing power. Productive use of RE will not only provides economical growth and tax revenue for government, but also create demand for renewable energy. With successful experience in China, it will be important that Chinese experts could join Ghanaian colleagues for resource mapping in the following sectors, especially target to –medium scale enterprises (Ghana standards).

The below sectors are general sector which RE could help, but need further mapping based on Ghana's situation in different regions:

1) Promotion of renewable energy to increase agricultural productivity.

- Farmland irrigation
- Water pumping for cattle
- Aeration pumps for fish and shrimp farms
- Egg incubators
- Potable water pumping,
- UV or ozone water purification

2) Agro-processing and food Processing

- including solar dryers,
- palm-processing plants
- multifunctional platforms for grinding and milling.
- Meat and fish drying
- Plant/seaweed drying
- Spice drying
- Coconut fiber processing
- Coffee and tobacoo processing
- Grain mills
- Lighting for processing plants

3) Cold storage for fish at landing sites.

- Refrigeration for storage (fruit, milk, etc.)
- Ice making for storage (fish, etc.)
- Cold chain transportation

4) Rural industries

- Sawmills
- Textile dyeing
- Salt production
- Materials Processing Gypsum processing
- Rubber drying
- Drinking Water Desalination

5) Biogas

- introduce institutional biogas systems for schools, hospitals, and prisons;
- Improved biomass systems for thermal energy and power generation for small-scale industrial applications (brick, tile & ceramic etc).
- Pig farms, chicken farms and cattle farms

4.2 Joint planning and integrated investment for both rural industries and RE

The development and promotion of small-scale or middle-scale productive opportunities for value-addition in communities, and the use of mechanical power to enhance production and efficiency is key important for economic growth in Ghana. Combine investment on both rural industries and RE actually reduce the barriers for each other.

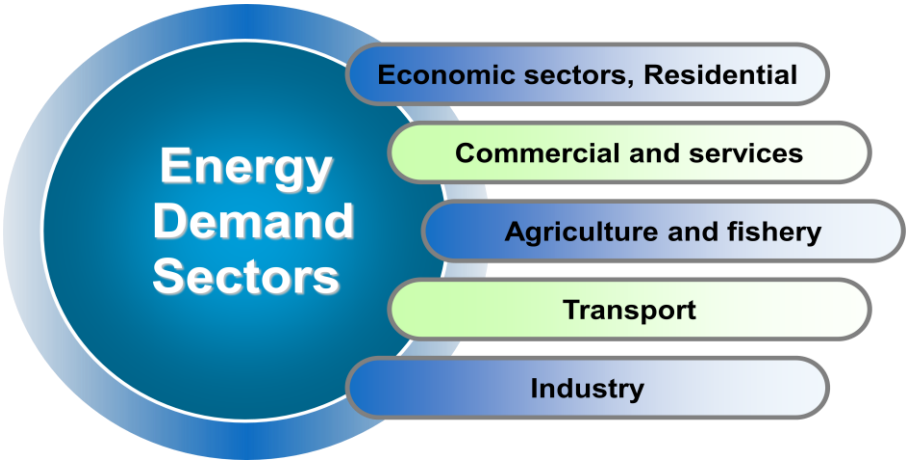


Figure 4.1 integrated investment for both rural industries and Productive use of RE

Many of China's RE projects actually work together with rural industries. In Ghana again resources mapping should be done first, with cooperation of local government and research agencies to identify how much resources, and the location of the resources of various types of RE

as well as energy demand associated with those resource. Many kind of RE, i.e. biomass, biogas, bio-fuel, pumped-storage power station, geothermal, energy efficiency improvement projects, and many others could be among the list for resources and demand mapping. Feasibility study is one of the key capabilities for both on-grid and off-grid RE system.

4.3 Technology transfer, deployment and market Transformation

Key area regarding to Technology transfer, deployment and market Transformation are:

RE Technology local adaptation

- Testing performance of RE Technology
- New RE product localization and overcome barriers to use
- Partner with stakeholders
- Reduce investment risks
- Development and implementation of codes and standards

Accessible to consumers

- Reliable and easy to use & maintain
- Affordable and secure in host country
- Attractive investment options
- Demand for marketplace
- Diverse supply option

Technology dissemination

- Business and management model study
- Data collection and analysis
- Problem identification
- Training

Besides introduce catalogs of Chinese RE products and do screening, it will be also important to add the following actions to project activities to ensure early market deployments support could help Ghana overcome non-technical challenges to the expansion of RE technologies into the broader vehicular marketplace.

- Demonstrating RE technologies in early market applications for which there is a business case
- Providing lessons learned in China on real-world implementation of rural electrification business model
- Eliminating non-technical barriers to widespread deployment
- Increasing opportunities for market expansion.

4.5 How to attract foreign investment and stimulate local banks for RE scale up

FDI played an important role in the scale-up of Chinese RE development. In china, start from 2001, FDI works with local banks and industries working along the value chain of RE project development and production. It is also important for FDI in helping the development of private sector's participation, together with SOEs enable China gradually phase out fossil energy, especially coal, and give low-carbon green electricity a prime part to play.

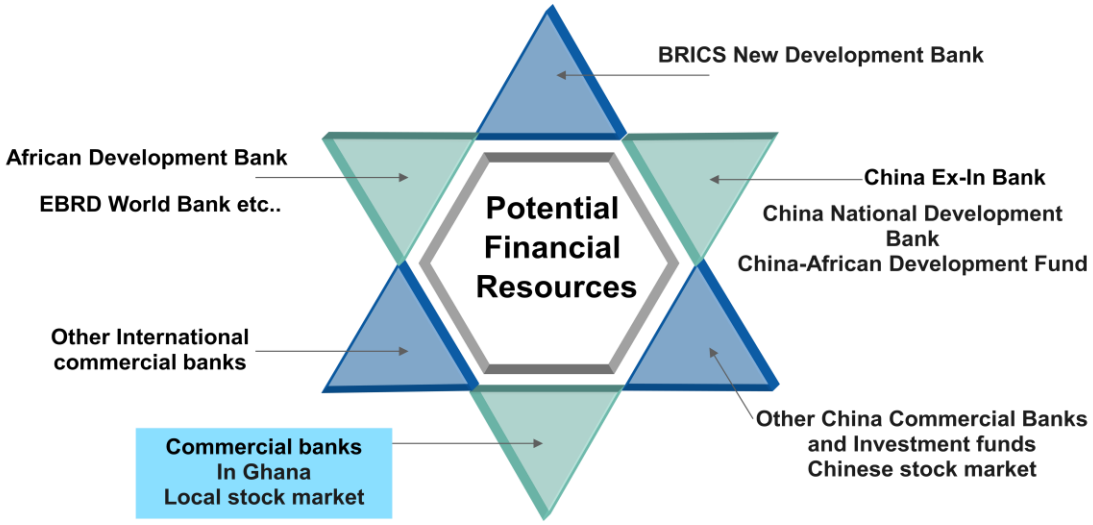


Figure 4.2 Introduction of financial support to RE sector

The Chinese team will also help the Ghana side in mobilizing financial resources not only from Chinese banks but also international banks to support RE development in Ghana, using their experience which has shown success in China. From Author's discussion with various stakeholders, there are huge cooperation potential between our project and other financial institutions (such as Eco-bank, BRICS Bank, China EX-IM Bank, ICBC, China Development Bank, World Bank and African Development Banks). If demonstration projects from UNDP program comes out as bundle, we need to construct an mechanism/platform to link with those banks. However the key fector for the apprach is the participation of local commercial banks in Ghana, to build their conficence and capacity for RE development in Ghana. Certain Green financing schemes could be disigned for Ghana later, which already have successful cases in China.

Under the project, it will be also necessary to set up an RE business incubator in Accra (better to be included in the RE Promotion Center mentioned in 4.1.1) , to support the private sector start-up companies working on Ghana's RE sector from a preliminary market stage. There is also needs for designing of investment fund to be set-up in Accra, to further support the market transformation.

There is also needs to help Ghana private sector companies to prepare Business plan and feasibility study reports for RE projects .

4.6 Training

China could supply technical support and introduce experts, knowledge, experiences, and organizations to establish partnership between Chinese renewable energy institution and Ghanan side. Chinese expert can help Ghana side to work with Chinese leading RE companies for future on-site training opportunities as well as donation of RE systems for demonstration (with supervision of ACCA21).

Appendix 1 Stakeholder and potential partners of this project

A1 National institutions (partially from Ghana Energy Commission 2015)

Ministry of Power*:* The Ministry of Power (MoP) oversees the energy sector, and is responsible for energy policy formulation and implementation. There are three mainline technical directorates: i) Generation and Transmission Directorate; ii) the Distribution Directorate; and iii) Renewable and Alternative Energy Directorate (RAED). In line with provisions of the Renewable Energy Act 832, the MoP established the RAED, which has the legal mandate to coordinate all efforts and manage the development and promotion of renewable energies in Ghana. More specifically, the RAED oversees: i) the implementation of renewable energy initiatives; ii) executes renewable energy programs and projects initiated by the State, or in which the State has an interest; and iii) manages the renewable energy sector assets on behalf of the State until such a time when the Renewable Energy Authority is established. The MoP has eight technical agencies or departments.

Energy Commission (EC)*:* The Energy Commission is the technical regulator of Ghana's electricity, natural gas and renewable energy industries, and the advisor to Government on energy matters. In this project EC serve as PMU and executing agency. The Energy Commission is mandated to: Advise the Minister of Power on renewable energy matters; Create a platform for collaboration between government and the private sector and civil society for the promotion of renewable energy sources; Promote public education and awareness on renewable energy technologies; Recommend for exemptions from customs, levies and other duties on renewable energy equipment and machinery; Recommend financial incentives for the development, production and utilization of renewable energy, in consultation with the Public Utility Regulatory Commission; Promote the local manufacture of components to facilitate the rapid growth of renewable energy sources; Promote plans for training and supporting local experts in the field of renewable energy; Promote the benefits of renewable energy to facilitate its utilization; Set targets for the development and utilization of renewable energy sources; andImplement the provisions of the Act. The Energy Commission is the implementation agency for UNDP-Zambia-China technology transfer project.

Public Utility Regulatory Commission (PURC): The Public Utilities Regulatory Commission was set up as a multi-sectoral regulator by the Government of Ghana in October 1997 as part of the utility sector reform process to regulate the provision of utility services in the electricity and water sectors. The PURC also has regulatory responsibility over charges for supply, transportation and distribution of natural gas services. The PURC is responsible for setting and approving rates chargeable for the purchase of electricity from conventional and renewable energy sources including mini-grids.

Environmental Protection Agency (EPA)*:* The EPA is the leading public body for protecting and improving the environment in Ghana. It is responsible for regulating the environment and ensuring the implementation of Government policies on the environment.

Electricity generation and transmission utilities*:* The bulk of the generation assets are owned by state-owned utility companies and Independent Power Producers (IPPs). The Volta River Authority (VRA) and Bui Power Authority (BPA) are the main public generation companies that operate Ghana's hydropower plants and some thermal power plants. A number of IPPs have also been licensed to build, own and operate power plants. The Ghana Grid Company (GRIDCo) owns and operates the transmission network.

Electricity distribution utilities: The distribution utilities are the Electricity Company of Ghana responsible for distribution services within the southern zone, Enclave Power Company for the Free Economic Zone and the Northern Electricity Distribution Company (NEDCo) responsible for distribution services in the northern belt.

A2 Development Partners (partially from Ghana Energy Commission 2015)

Ghana's development partners have provided significant support to its energy sector through harmonized assistance which is aligned with national priorities and strategies (MoP, 2015). Ghana has a well-coordinated working group of Development Partners involved in the energy sector which is currently being co-chaired by the African Development Bank on the Development Partners' side and the Chief Directors of the Ministry of Petroleum and Ministry of Power on the Government of Ghana side. The energy sector working group comprises the various Development Partners assisting the country through various financing instruments including:

African Development Bank (AfDB), World Bank (WB), European Union (EU), United Nations Development Program UNDP), Agence Française de Développement (AFD), Kreditanstalt für Wiederaufbau (KfW), Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ), Millennium Challenge Corporation (MCC) and Switzerland State Secretariat for Economic Affairs (SECO). The group meets regularly to discuss key sector issues and challenges, as well as Development Partners' approaches and interventions to address them. In addition, in 2014, AfDB and SE4all set up the African Climate Technology and Finance Center and Network.

The AfDB, SECO and the World Bank are supporting the Ghana Energy Development and Access Project (GEDAP) in which one component promotes a mix of renewable energy-based models including four pilot mini-grids to serve nearly 10,000 people in selected deprived communities. The Government of Ghana intends to scale-up this initiative, building on the success of the

GEDAP mini-grid project. KfW is working with the Volta River Authority to develop a 12 MW solar PV project. The Volta River Authority will own and manage the solar plant, which is expected to be constructed in early 2016. KfW is keen to continue investing in the renewable energy sector in the coming years as their new programming cycle starts in 2017. The GIZ's support on renewable energy focuses on technical assistance for the implementation of the Renewable Energy Act and implementation of productive use of energy for on-grid and off-grid operations, as well as financing for small-scale projects with successful results-based-evidence schemes (MoP, 2015), including:

- Productive use of energy in agriculture: which involves grid electrification and solar PV pumping for irrigation, and productive use of electricity in 18 light industrial zones in five regions (EnDev);
- Improved cooking stoves for gari (processed cassava) processing in partnership with the SNV, a Dutch NGO (EnDev); and
- Advisory services on the capacity for successful implementation of the Renewable Energy Act on renewable energy scenarios, including a preliminary grid impact study, the FiT scheme (including tariffs and renewable energy purchase obligations), net metering, standardized renewable energy power purchase agreements (PPAs), pilot tenders for variable renewable energy, credit support and technical and organizational development training (Ghanaian-German cooperation).

The EnerGIZing Development Program (EnDev) is managed by GIZ, and it is supporting a range of pilot small-scale renewable energy activities promoting access to energy and productive use of energy. The program is funded by:

- Dutch Ministry of Foreign Affairs (MFA NL);
- German Federal Ministry for Economic Cooperation and Development (BMZ);
- Norwegian Ministry of Foreign Affairs (MFA NO);
- Australian Agency for International Development (AusAID);
- UK Department for International Development (DFID), and
- Swiss Agency for Development and Cooperation (SDC).

InfoDev, a global multi-donor program in the World Bank Group, supports growth-oriented entrepreneurs through creative and path-breaking venture enablers. InfoDev is supporting the establishment of a Climate Innovation Centre (CIC), with support from the Danish Ministry of Foreign Affairs and led by the Ashesi University College in Ghana. CICs are designed to provide climate technology entrepreneurs with the mentorship, financing, networks, and business services they need to scale-up their innovations, driving down carbon emissions and creating sustainable, inclusive jobs.

A3 Non-governmental organizations

Some international and local non-governmental organizations (NGOs) have also been actively

supporting development and deployment of renewable energy in Ghana. The Netherlands Development Organization (SNV), an international not-for-profit development organization contributes to poverty reduction with the implementation of several renewable energy projects including, activities on the role of gender in agro-processing, improved cook-stoves, improved fish-smoking and small-scale energy enterprises.

The Kumasi Institute of Technology, Energy and Environment (KITE) a Ghanaian NGO has been involved in the development and implementation of public benefit projects in the energy and environment sectors of Ghana. KITE developed the Energy for Poverty Reduction Action Plan for Ghana (EPRAP) and the business development services package for African Rural Energy Enterprise Development (AREED) to promote private partnerships in the clean energy sector. SNV and KITE are already active partners in the Ministry of Power's renewable energy initiatives including the GEDAP project. NewEnergy, another Ghanaian NGO in Tamale in the Northern Region of Ghana has been engaged in activities on renewable energy services, environmental conservation, enterprise development training, microcredit support, water and sanitation services as well as policy advocacy.

African Climate Technology and Finance Center and Network,

the centre is aligned with the Sustainable Energy for All (SE4ALL) initiative and the African Development Bank's (AfDB) Sustainable Energy Fund for Africa (SEFA) and will support the mainstreaming of low carbon and clean technologies in SE4ALL Action Agendas and Investment Prospectuses. Water management, with its important impact on agriculture, industry, and urban and rural populations is a key area for adaptation measures. On the adaptation side, the centre will be complementary to the bank-hosted Africa Water Facility and the Rural Water Supply and Sanitation Initiative (RWSSI). The centre will address some of the key issues related to access to information and expertise relevant to the African context, such as dissemination of best practices, weak enabling environments at the national level, and lack of bankable projects. The AfBD will collaborate with public and private sector stakeholders in Africa and civil society involved in enhancing and disseminating knowledge, improving the enabling environments and in planning, financing and implementing mitigation and adaptation investments.

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