United Nations Environmental Programme (UNEP)

Frankfurt School of Finance & Management

In collaboration with

Ecobank Transnational Incorporated (ETI)

African Green Business
Market Assessment
Ghana

Country Study

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Content

1 Market Environment for Green Businesses

1.1 Country background

1.1.1 Macroeconomic Environment

Ghana has made considerable progress in laying the foundation for sustainable growth and poverty reduction through steady reforms since the mid-1980s, resulting in per capita output growth averaging 1.6% per annum and increased private sector activity. Under the NPP government (2000 – 2008), the rate of inflation declined as a result of improved fiscal and monetary management, debt relief, structural reforms and a supportive international environment. However, in view of internal and external factors including the 2008 national elections, the African Football Cup, rising global food and oil prices, the fiscal deficit rose to 14.5% of GDP and inflation increased from 10.9 percent in 2006 to 18.1% in 2008.

The Ghanaian Cedi which was denominated only in July 2007 depreciated by 50 percent against the dollar, and official reserves fell to 2 months' import cover. Yet, at the same time, Ghana's economy grew at a two-decade high of 7.3% based on persistently strong credit expansion to the private sector, buoyant remittances, and strong agricultural yields. The consolidating fiscal policy of the new government aiming at public debt stabilization through expenditure restraint, tax increases and budget support from the international community resulted in lower inflation and improved budget balance (14.6 percent and -9.4 percent, respectively, in 2009).

Based on the prospects for a continuation of the disinflation process and improvements in economic activity and output growth, the prime rate was reduced by 200 basis points from 18 percent to 16 percent in February 2010. Accordingly, commercial interest rates are expected to decline further as interest in Treasury Bills has dropped below 18 percent and banks are looking at other sources of bank income.[1]

1.1.2 Financial Sector

Government commitment to financial sector reform since the late 1980s included the Financial Sector Strategic Plan which reformed the regulatory and institutional environment. The commercial banking system has seen increasing competition in recent years, though it remains largely dominated by a few major banks that target mainly urban middle-income and high net-worth clients. The Rural and Community Banks as well as the microfinance institutions have increased access to financial services to the broader population, inducing traditional banks downscaling into new markets. The financial sector has been resilient to the initial impact of the global financial crisis. Due to a strong regulatory and supervisory framework and limited integration of Ghanaian banks with global markets, the impacts of the financial crisis have been limited and mainly indirect through declining remittances and more cautious lending standards. But risks have accumulated in an environment of rapid banking expansion, strong competition, and increased risk taking. A recent deterioration in loan books could continue, based on rising funding costs and currency depreciation, which has been mitigated by steps to increase minimum capital.[2]

1.1.3 Business Environment

The World Economic Forum ranks Ghana 114th out of 133 countries in its Global Competitiveness Index 2009 – 2010 (worsening from rank 102 in 2008 – 2009), and the World Bank Doing Business Report 2010 places the country on rank 92 out of 183 economies reflecting the numerous administrative procedures for obtaining required licenses and the comparatively high barriers for accessing credit as result of the lack of credit information. However, with regard to investor protection Ghana is among the top 50, indicating greater disclosure, greater liability of directors and greater

[1] IMF Article IV Report, 2009.

[2] IMF (2009), Country Report No. 09/256; World Bank (2007), Project Appraisal Document.

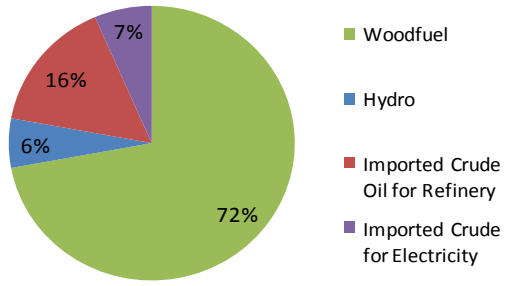
powers of shareholders to challenge the transaction. In Transparency International's Corruption Perception Index, Ghana is confidently ranked at 69 throughout 2007 and 2009.[3]

1.2 Energy Sector Overview

1.2.1 Primary Energy Supply Balance

Ghana's primary energy supply balance for all locally available and imported primary energy commodities includes woodfuel, hydro, and imported crude. At 72%, woodfuel remains the single most important energy source for Ghana.

Figure 1: Primary Energy Supply Balance by Energy Type (2008)

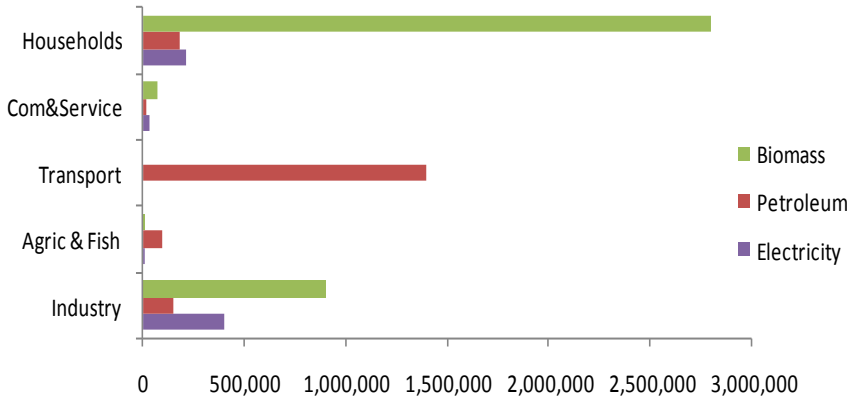


Source: Energy Commission, 2009.

1.2.2 Final Energy Consumption Balance

Ghana's final energy consumption can be divided into three main sub-sectors: petroleum, electricity and traditional biomass.

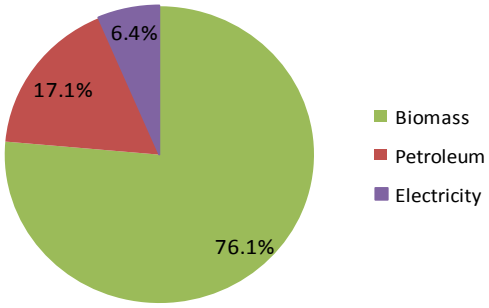
Figure 2: Consumption by End-Use Sector (2005, in thousand tonnes of oil equivalent)



Source: MoE/EC, 2009

Figure 3: Composition of Fuels in Final Energy Consumption (2008)

[3] World Economic Forum (2009), The Global Competitiveness Report 2009 – 2010; World Bank (2009), Doing Business 2010; Transparency International (2009), Corruption Perception Index.



Source: Energy Commission, 2009.

The large part of the national energy basket, 76.1%, is made up of traditional biomass, i.e. fuelwood and charcoal, of which about 90% are obtained from the natural forest and 10% from wood waste such as logging and sawmill residue and planted forests. In 2008, about 9.1 million tons were consumed in the form of firewood and 7.3 million tons in the form of charcoal. Wood fuels provide the bulk of the energy needs for most informal enterprises such as bread-baking, processing of oil palm, brewing of local drinks, tobacco curing, traditional textiles and soap making, and fish smoking.

Due to free and easy access, most rural households (76%) still cook with fuelwood compared to only 19% of urban households. The lack of feasible alternatives and source of income for the rural population explains why its usage has been constantly increasing over the last years (from 10.7 million tonnes in 2000 to 16.4 million tonnes in 2008). Under moderately high economic growth scenarios, future demand for wood to be used as firewood and charcoal will increase to 45 million tonnes by 2020. Accordingly, deforestation, desertification and land degradation are predominant environmental issues linked to energy resources in the country. [4]

The petroleum sector constitutes 17.1% of the final energy consumption. The nation imports and consumes significant volumes of petroleum. In 2008, 1.98 million tonnes of crude oil were imported and 1.84 million tons consumed. The petroleum sector covers upstream activities (exploration) and downstream activities (refining by the Tema Oil Refinery (TOR), storage and distribution by oil marketing companies). Following the recent oil discovery in Ghana, which is possibly one of the largest oil finds in the last decade off the shores of West Africa, the country aims to become a net exporter of oil and power by 2013 and to build up the energy sector to become a national revenue and economic growth engine. Available estimates suggest that crude oil exports will be in the range of USD 2 billion to USD 3.2 billion between 2010 and 2030; fiscal revenues from crude oil exports are forecasted at USD 700 million in 2010, rising to USD 3 billion by 2013. Exploitation of the Jubilee oil field will commence in the last quarter of 2010.[5]

Table 1: Installed Electricity Generation Capacity and Electricity Generation (2008)

[4] ESMAP, 2006; Energy Commission, 2006/2009
[5] AEO, 2009, Budget Statement for the Fiscal Year 2010

Power Generation Site	Installed Capacity	Installed capacity (% of total)	Electricity Generation	Electricity Generation (% of total)
Akosombo Hydropower Plant	1,020 MW	50.7%	5,254 GWh	63.1%
Kpong Hydropower Plant	160 MW	8%	941 GWh	11.3%
Takoradi Power Company (TAPCO) Thermal Power Plant	330 MW	16.4%	874 GWh	10.5%
Takoradi International Power Company (TICO) Thermal Power Plant	220 MW	10.9%	1,063 GWh	12.8%
Tema Mines Diesel Reserve Plant	80 MW	4.0%	46 GWh	0.6%
Tema Emergency Diesel Reserve Plant	126 MW	6.3%	45 GWh	0.5%
Tema Diesel Reserve Plant	25 MW	1.2%	85 GWh	1.0%
Tema Diesel Plant	30 MW	1.5%	0 GWh	0.0%
Kumasi Diesel Reserve Plant	20 MW	1.0%	16 GWh	0.2%
Total	**2,011 MW**	**100%**	**8,323 GWh**	**100.0%**

Source: Ghana Energy Commission, 2009.

The electricity sector accounts for about 6.4% of the total energy consumed. Currently, the country has available capacity of 2,011 MW as broken down in Table 1. The in-country generation of power amounts to 8,323 GWh on annual average and is dominated by hydro electric sources. Due to falling water levels, thermal power has become more important as source of electricity generation, especially as back-up during peak hours from 7 – 10 p.m., with shares for thermal power increasing from 8.5% in 2000 to 25.6% in 2008 in total electricity generation (from 613 GWh to 2,128 GWh).

Apart from in-country generation, 275 GWh of thermal power was imported from Cote d'Ivoire in 2008 to supplement domestic demand which is growing at 9% per annum as a result of population growth, rural electrification and industrial expansion. The industrial sector is the largest consumer of electricity (37% in 2008), followed by the residential sector (28%). The non-residential sector accounted for 11% of total electricity consumption. The remaining 24% can be attributed to distribution and transmission losses.

In 2004, about 54% of the population had access to electricity supply, the third highest rate in Sub-Saharan Africa after Mauritius and South Africa. Currently, experts estimate the national electrification rate at 64%, more than doubling from 28% in 1989 when the National Electrification Scheme (NES) was launched. The Deputy Minister in an official address in February 2010 confirmed that currently 65% of the population had access to the electricity grid.[6] Nevertheless, there are huge disparities between urban and rural areas (78.8% and 23.8% respectively). Per capita electricity consumption was estimated to be 272 kWh per year in 2008, which is below the Sub-Saharan weighted average of

[6] MoE, 2010, http://www.energymin.gov.gh/download/address.pdf.

475 kWh. Over 80% of electricity is consumed in urban areas. The lack of sufficient diversity in power sources exposes the country to the risk of inconsistent power generation and significant power shortages in times of drought and changing rainfall patterns. In 2003 and 2007, electricity generation fell below 4,000 GWh and induced the government and mining companies to procure diesel reserve plants of 126 MW and 80 MW, respectively.[7]

Since the diesel plants are powered by (hitherto imported) expensive fuel and natural gas, they have exerted significant pressure on the national budget. Apart from the mono-structured electricity generation based mainly on large hydro power, power availability and reliability is also constrained by the weak financial position of the public utilities. Due to the low tariffs set by the government, the utility companies are unable to recover their short-run marginal cost leading to high losses and system failures. As a result, the energy sector has been declared 'one of the greatest risks to the economy' in the 2010 Government Budget.

Businesses and households have to bear the high cost of resorting to alternative energy sources and the reduced levels of supply. The Global Competitiveness Report 2009/2010 ranks Ghana very low in the quality of electricity supply, on 101 out of 133 countries (Kenya 91, Senegal 113, Rwanda not ranked). The industrial and service sectors, which jointly account for nearly 75% of Ghana's GDP, rely critically on electricity and displacements in availability impact the operations of the sectors. The single largest electricity consumer (33% in 2000), the formerly government-owned aluminium smelter VALCO, has frequently been shut down in times of low water levels in the Akosombo Dam. To date, one third of households experience power failures every day or several times a week, which last anywhere from a few hours up to 3 days.[8]

The assumed techno-economic data of existing and expected future power plants in Ghana and the cost assumptions for future power plants have been taken as the average of estimates reported for various countries in a study by the OECD/NEA/IEA (OECD, 2005). This data can be found in the Annex.

1.3 Potential for Renewable Energy and Energy Efficiency

1.3.1 Renewable Energy Sector

Ghana is endowed with abundant renewable energy (RE) resources including solar, wind, hydro resources and biomass which could supplement the traditional sources of energy for the country. Ghana is rich in solar resources, receiving an average annual solar radiation of 16 – 29 MJ/m², with an annual sunshine duration of between 1,800 and 3,000 hours. The development of Solar-PV and solar water heaters has been mostly financed through grants and concessional loans from donors and government programs, such as DANIDA, the Spanish government, and UNDP/GEF. As a result, about 5,000 Solar-PV systems with a working capacity of 1 MW have been installed.

The UNEP Solar and Wind Energy Resource Assessment project has found the strongest wind regime along the Ghana/Togo border: 9.0-9.9 metres per second wind speed[9] that can yield a wind power density of 600-800 Watt/m2 in the mountains over an area of about 300-400 square kilometres. The total wind energy potential of this area has been estimated at around 300 MW in capacity or 800 GWh in generation. Over a large area along the coast, high winds (6.2-7.1 metres per second at the height of 50 m) are also present reflecting a total potential of around 3000 MW capacity or 7,300 GWh of electricity.

Marginal or moderate wind power density (200-400 W/m2) occur in other parts of the country putting the estimated potential of scattered off-grid wind turbines at about 500-800 MW capacity or 1,100-1,700 GWh electricity. The wind potential at the Ghana/Togo border (Volta Region) and along the coast of the Gulf of Guinea is suitable for grid connected large wind farms while the scattered wind potential can be exploited through stand-alone wind turbines. For

[7] The 2007 energy crisis necessitated a shift from hydro to a more costly thermal-power generation at a time of rising crude oil prices. In the circumstance, the government introduced subsidies to enable consumers to operate a cost-recovery pricing mechanism during the period of acute power shortages. As a result, petroleum prices in Ghana are currently the cheapest in the West African region, providing huge incentives for smuggling and causing shortages in the country. Studies are underway to assess the impact of re-imposition of taxes on petroleum products on household activities and economic growth.

[8] ESMAP, 2006; Energy Commission, 2009.

[9] A wind energy system usually needs an average wind speed of at least 5 metres per second to be practical. Typical annual average wind speed of wind farms is between 6 – 7 m/s.

wind energy systems that are directly tied to the utility grid network, the grid system must be large enough to be able to withstand fluctuations in wind power.

The unexploited hydropower potential may be in the order of 2,000 MW according to the Energy Commission. The Government has identified nearly 20 medium to large hydro sites (20 – 400 MW each), and other studies have found potential for the development of 70 small hydro sites (~ 10 MW). Identified mini hydro resource sites are about 3 MW with corresponding annual generation potential of about 15 GWh. Ghana has pioneered research on biofuel and Jatropha plantations in West Africa.

Ghana has pioneered research on biofuel and Jatropha plantations in West Africa. Bio-diesel generated from Jatropha, sugarcane, oil palm, soya bean oil, or coconut oil can supplement costly regular diesel, for instance for powering grain mills in off-grid communities. The technology has been tested in several villages in the country indicating promising prospects to substitute for regular diesel. The most attractive plant for cultivation and biofuel processing are Jatropha and sugarcane. Though the technology is still relatively young, small farmers are promising clients to use biofuel on a local scale for lighting and agro-processing.

Further research is focusing on reducing production costs and improving farming techniques to reduce the risk of low yields, pests and disease. Ghana also offers potential for biomass based electricity production from wood-residues (e.g. from sawmills). The annual production of wood residues from logging and sawmills is estimated to be around 1.1 million tons indicating a large potential for biomass cogeneration from wood wastes and agriculture residues. Some biomass-fired co-generation projects have been implemented in the oil palm industry, but are under-utilised. The main factors hindering their exploitation especially in the wood processing industry are the lower cost grid power and the hitherto lack of financial or fiscal incentives that would encourage them to generate and sell electricity to the grid.

Biogas technology processing municipal and farm waste has been demonstrated for cooking, direct lighting, small power generation, and bio-sanitation in hotels, schools, hospitals, and other public institutions. Bio-latrines are being promoted throughout the country. The development of the country's RE resources has been seen as a credible option for potentially relieving some of the energy needs of the poor and securing the country's energy needs. Even though Ghana is endowed with a variety of renewable energy resources, the contribution of solar, wind, biofuel and small hydro to the energy mix is still negligible to date due to improper public sensitisation, information asymmetries, marketing strategies, lack of feed-in-tariffs and high upfront costs. Accordingly, the main renewable energy source in Ghana is still coming from large hydropower plants as the cheapest form of electricity generation.

1.3.2 Energy Efficiency Sector

- Increase Energy Production Efficiency

Charcoal production is still largely based on the rudimentary earth mound technology which is low yielding consuming between 4 – 6 tonnes of wood per every tonne of charcoal produced. The Ahibenso improved stove was introduced on the market in 1989 as part of the woodfuel efficiency programme under the National Energy Board. It saved between 35 – 40% of charcoal and 15 – 20% of money normally spent on the traditional coal pot. Success of the programme was constrained due to its focus on the production side instead of also accommodating the customer side in order to grow the market.

- Consumption

Considering the enormous wood demand under the moderate and high economic growth scenarios in the medium to long-term, doubling to 45 million tons of until 2020, the informal industrial and commercial/service subsectors of the economy need to be encouraged to switch to alternative fuels and more efficient appliances to reduce wood demand. According to estimates by the Energy Commission (2006), wood demand can be reduced by one to two million tons per year through nationwide promotion of energy efficient stove and conservation programmes (for instance, improved cookstoves and charcoal production technologies as well as briquetting), and thus complement the expansion of forest plantation in meeting the country's energy needs. The industrial opportunity for gas cylinder manufacturing, LPG refinery and distribution will be immense. Yet, it is likely that a significant proportion of the informal and commercial/service sectors will be reluctant to change unless the shift to more efficient fuels and appliances is supported with financial incentives since the traditional firewood and charcoal stoves are still the least expensive cooking device regarding initial capital investments. Improved charcoal programmes and production kilns will create jobs for rural entrepreneurs involved

in the fabrication of charcoal and firewood stoves, and will in the medium-term attract CDM and other climate change related funding to the country.

Some of the Ghanaian energy-intensive industry offers a good potential for reduction of electricity consumption. This is especially the case for the three electric arc furnace steel plants, the aluminium smelting plant of VALCO as well as the textile and rubber industry. The majority of the energy-intensive industry as well as the VRA is considering to switch from fuel oil to natural gas (e.g. in industrial boilers and power plants) once gas is being delivered through the West African Gas Pipeline (WAGP), which was completed over a year ago and contracts to deliver the gas have been signed, but due to technical problems the gas has not been flowing yet.

- Distribution

Due to lack of investment, Ghana's transmission system is old. 40% of the system is more than 40 years old, 20% of the system is 25 years old and the remainder about 15 years. Delays in rehabilitation have occurred due to tariff levels that have been insufficient to cover costs. As a result of high demand growth and delayed routine maintenance, the distribution networks are overloaded resulting in high losses and service interruptions. Total losses in the Electricity Company of Ghana (ECG) and the Northern Electricity Department (NED) were about 8,066 GWh (24% of electricity output) in 2008. A large part of these losses (about 18%) are "non-technical", i.e. they derive from pilferage of electricity, billing inefficiencies, and inadequate metering.[10]

1.4 Institutional Framework

The following is a description of the institutional framework for RE and EE in Ghana. Also presented are the institutional and legal framework and the current energy policy followed by the government.

1.4.1 Institutions

The energy system in Ghana is basically managed by the public sector.

- Ministry of Mines and Energy (MOME)

The Ministry of Mines and Energy is responsible for formulating and implementing energy and electricity policies. It also supervises the operations of Ghana National Petroleum Corporation, the Tema Oil Refinery, the Volta River Authority, the Electricity Company, and has oversight responsibility over the Energy Commission. In order to further develop the solar and renewable energy programmes, the Ministry established on the Renewable Energy Services Project (RESPRO) with funding support from the Global Environment Fund through the UNDP.

The Renewable Energy Division is responsible for developing and elaborating national policies and strategies for all renewable resources, technologies, demand and supply side management and generation: solar PV systems for both stand-alone and grid connected; wind energy resource assessment and generation, small hydro development, biomass/biofuel and woodfuel resource assessment, development and generation.

- Ministry of Environment, Science and Technology (MEST)

The Ministry of Environment, Science and Technology (MEST) exists to establish a strong national scientific and technological base for accelerated sustainable development of the country. By September 2010, MEST in collaboration with an international consultant will have developed Ghana's Low Carbon Growth Strategy, which strives to ensure the supply of sustainable, affordable, safe and reliable energy for domestic and industrial use.

The draft strategy paper encompasses (1) promotion of RE research and development programmes, including to up-grade hydropower energy production technology, sensitization and dissemination of energy technology in rural electrification facilitating ownership; (2) facilitation of efforts to acquire and adapt sustainable safe and economical energy technologies; (3) promote public support for energy conservation; (4) encourage private and community investment, (5) exploit the utilization of nuclear energy resources for domestic and industrial use, and (8) develop an integrated petrochemical industry to respond to the oil and gas industry. Following this document, the Government will establish a climate fund which would involve the creation of a gender fund to assist women and children to support mitigation and adaptation

[10] Energy Commission, 2009

actions. In addition, the Ministry as part of its programme promotes afforestation and sponsors journalists to specialize in environmental reporting with regards to climate change.

- Regulating Agencies

The Energy Commission of Ghana is the primary regulator for the energy sector in Ghana setting the technical standards for the electricity and petroleum sectors (in collaboration with the National Petroleum Tender Board). The Energy Commission also sets the standards for the export of charcoal, licenses RE businesses and gives out permits for importing of RE components. The Commission also advises the Government on energy policy and strategy, including the RE draft bill that will provide a level playing field for potential developers of RE energy production and climate change mitigation in Ghana.

The Commission is dedicated to the exploitation of Ghana's renewable energy resources for which it utilizes funding from the Energy Fund (Act No. 541). The Fund raises about USD 500,000 a year from levying petroleum products, which is however insufficient to support large-scale RE development, as stipulated its Strategic National Energy Plan 2006 – 2020 (SNEP) which targets 10% of RE sources to be in the energy mix by 2020 (excluding biomass and large hydropower). The Commission is also involved in indicative planning of energy and electricity system expansion, and licensing of energy sector operators. The Public Utilities Regulatory Commission (PURC), which was established in 1997, is the prime body for monitoring price, setting tariffs, ensuring quality of service and framing customer service regulations.

- Electricity Generation, Transmission and Distribution

The electricity generation and transmission functions lie with the publicly owned Volta River Authority (VRA), while electricity distribution in the Southern part of the country is the responsibility of the Electricity Company of Ghana (ECG), supplying 1.72 million non/residential and 11,136 industrial customers as of 2008. The Northern Electricity Department (NED) under the VRA is responsible for distribution in northern Ghana having 278,000 non/residential and 31 industrial customers. In order to decentralize and open the power sector to Independent Power Producers, institutional reforms of existing power utilities were undertaken in 1998. The newly established Ghana Grid Company (GRIDCO) will replace the transmission department of the VRA and acts as broker between IPPs and VRA. The first private partner to enter the market, CMS of Michigan, bought 51% in a joint venture with VRA to set up the 220 MW Aboadze thermal power plant.

- Other Agencies

The Ghana Energy Foundation, established in 1997, is a not-for-profit public private partnership devoted to promoting the sustainable development and efficient consumption of energy in Ghana by offering EE and RE solutions to residential, industrial and commercial energy consumers. The Executive Council consists of the Association of Ghana Industries (AGI), Private Enterprise Foundation (PEF), Ghana National Chamber of Commerce & Industry (GNCCI), Ghana Chamber of Mines (GCM), Volta River Authority (VRA), Electricity Company of Ghana (ECG) and Volta Aluminium Company Ltd (VALCO).

Its activities include energy audits and energy management strategies, power and factor correction, electrical load management, heat recovery, monitoring and targeting energy management, tariff analysis, refrigeration and air conditioning analysis, outreach programmes to educate the public, demonstration and promotion of RE and EE technologies. The Foundation has used formal and informal communication with policy makers and energy sector stakeholders to raise electricity tariffs to economic levels and successfully advocated for a reduction on import tariffs for energy efficient products and renewable technologies. As early as 1999, it organized the first National Forum on Energy Efficiency Technologies and has held several exhibitions for energy efficiency technologies, round table meetings and workshops for local banks and international financial entities.

The Environmental Protection Agency (EPA) provides the framework legislation for environmental assessments in Ghana. According to Act 1994, EPA is mandated to advise the Minister of Energy on formulating environmental policies and to make recommendations for the protection of the environment, to coordinate activities of domestic environmental bodies and with international agencies, to develop a comprehensive database on environment related issues and environmental protection, and to conduct training seminars for public sensitisation.

The Kumasi Institute for Technology and Environment (KITE), has gained international acclaim for its innovative and effective RE and EE interventions. Since its inception in 1996, KITE has supported policy research, knowledge management, the development of entrepreneurial skills and empowerment of indigenous entrepreneurs in order to help providing modern energy services in rural and peri-urban areas in Ghana and the ECOWAS region. In partnership with local and international organizations, the institute has attracted more than USD 15 million in development assistance, executed 40 projects, established more than 100 energy businesses, organized more than 100 capacity building workshops, and has built the capacities of about 1,000,000 entrepreneurs and stakeholders. KITE has had impact on over 100 communities, and has directly served around 2,000,000 people. Table 2 summarizes KITE's ongoing activities.

Table 2: Ongoing KITE projects

Project Name	Objective	Measures
Rural Energy Supply and Utilisation Program (RESUP)	Sustainable production and utilization of energy, focusing on alternative bio-energy feedstock and improved conversion technologies	Identification and deployment of new technology options. Finance and capacity building to formal and informal sector
Energy and Productivity Program (EPP)	Improve productivity levels of SMEs in rural and peri-urban areas in Ghana	Promotion and introduction of modern energy technology and services in SMEs. Enterprise development services, facilitation of funding and technical support
Energy and Environment Program (EEP)	Facilitate knowledge sharing and technology transfer	Promote and demonstrate the sustainable use of RE and non-renewable energies
Clean Energy and Technology Investment Program (CETIP)	Development of viable energy business opportunities into commercial enterprises	Technical and financial support to viable energy businesses Start-up capital
Knowledge Management Program (KMP)	- Keep stakeholders abreast with new developments in energy sectors and global industrial/technological trends and funding opportunities	- Channelling information through various formats and means of communication

Source: KITE, 2010

The Energy Centre at Kwame Nkrumah University of Science and Technology (KNUST) represents another leading agency in the development of RE and EE projects, including the Renewable Energy Education Project (REEP) supported by the European Union's Africa, Caribbean and Pacific (EUACP) Secretariat, the Biofuel SME Project supported by Trust Africa (a joint initiative of Ford Foundation and the International Development Research Centre (IDRC) of Canada), and the Renewable Energy Enterprise Development (REED) project. KNUST also hosts the Solar Laboratory at Mechanical Engineering Department and Agricultural Engineering Department. Other vital research institutes in the fields of biofuels and deforestation are the Council for Scientific and Industrial Research (CSIR) which coordinates scientific R&D at eight agricultural research institutes, and the Forestry Research Institute of Ghana (FORIG).

The GIS-based Energy Access Project, supported with a EUR 180,000 grant from EUEI-PDF, contributes towards the effective implementation of policies and plans for achieving energy access targets through the use of a geographic information system (GIS) to collate and analyze national level data and provide timely information for policymaking purposes in Ghana. The project is meant to be a pilot project which will be replicated in ECOWAS countries provided continued support from UNDP. An RE Master programme is in pipeline.

The Lighting Africa National Advisory Committee (LANAC) was set up in August 2009 in Accra, and comprises consultants specializing in the off-grid (solar) lighting markets in Ghana. IFC contracted KITE to provide technical support for setting up the Committee in Ghana and Kenya. LANAC provides programme staff on programmatic and strategic issues and acts as liaison for potential investors and customers informing on financing sources, consumer protection and targeting strategic markets.

1.4.2 Industry Bodies

Established in March 2006, the Association of Ghana Solar Industries (AGSI) is hitherto the sole industry body representing green energy businesses. Although open for membership to all RE businesses and interested individuals, the Association is mainly shaped by the strong solar industrial companies. The major firms (i.e. Deng and DWA Dizengoff) are also members of the Association of Ghana Industries, but rather passive compared to the strong players engaged in oil extraction, so that the Association has so far not promoted any changes in the policy formulation and regulations related to the RE/EE sectors.

Stakeholders have expressed their interest in upgrading AGSI to an umbrella association for all RE businesses in the near future. Under the GEDAP program, AGSI is receiving USD 500,000 enabling the Association to conduct enhanced Solar-PV promotion campaigns and training programs to local Solar-PV dealers.

1.4.3 Laws and Codes

Under the "Energy for Growth" strategy, the power sector reform will continue with the preparation of a National Electricity Grid Code, Natural Gas Occupational Health and Safety Regulations, and a Renewable Energy Law (see below). At the Public Utilities Regulatory Commission (PURC) and the Energy Commission (EC) capacity development efforts will be pursued to enhance their regulatory oversight of the energy sector. Furthermore, a review of all IPP contracts will be undertaken to ensure compliance with the laws.

- Electricity Regulations

The current framework for gas and electricity supply, distribution and transmission encompasses:

- L.I. 1816: Electricity Supply and Distribution (Technical and Operational) Rules, 2005;
- L.I. 1911: Natural Gas Distribution and Sale (Technical and Operational) Rules, 2007;
- L.I. 1912: Natural Gas Distribution and Sale (Standards of Performance) Regulations, 2007;
- L.I. 1913: Natural Gas Transmission Utility (Technical and Operational) Rules, 2007;
- L.I. 1934: Electricity Transmission (Technical, Operational and Standards of Performance) Rules, 2008;
- L.I. 1935: Electricity Supply and Distribution (Standards of Performance) Regulations, 2008;
- L.I. 1936: Natural Gas Transmission Utility (Standards of Performance) Regulations, 2008;
- L.I. 1937: Electricity Regulations, 2008.

Under the Electricity Supply and Distribution Standards of Performance Law (2005), PURC will begin to apply penalties to companies in the power sector for breach of standards of performance, effective from October 16, 2010. After a 5-year transitional period, the companies will then be charged penalties ranging from two to 200 units (each unit having a value of GHC 12 or USD 8.32)[11] for every instance of the breach. The penalties are meant to improve service delivery by the electricity companies and protect consumers from under-performance, including delays in service delivery, supply interruptions, extended use of estimated billing, delays in the provision of replacement of electricity metres for consumers and the failure to ensure that a vending point exists within 10 km of the customer's premises.

- Tariffs

The price of electricity in Ghana is far below the short-term marginal cost of electricity, which is about GHC 0.04 per kWh (USD 0.028) from large hydro and GHC 0.28 (USD 0.1935) from thermal sources. Tariffs well below the cost tend to increase power demand, accelerating both the depletion of water resources and the downward spiral of VRA's and ECG's finances. As a result, VRA and ECG do not have sufficient funds to maintain and expand the power system leading to high losses and system failures. In addition to creating a financial crisis for the public utilities, the low tariffs also prevent RE producers to sell their generated electricity to ECG or NED since they cannot compete on a cost level with the subsidized prices of the public utilities (Table 3).

[11] Exchange rate as of Feb 14, 2010.

Table 3: Electricity End User Tariff (2010)

	Electricity from Public Utilities*			Solar	Wind
	Bulk Supply Tariff (BST)	Distribution Service Charge (DSC)	End User Tariff (EUT)		
Price (GHC/kWh)	0.0611	0.0585	0.1196	0.8462	0.2115 – 0.2820
Price (USD/kWh)	0.04	0.04	0.08	0.60	0.15 – 0.20

Source: Energy Commission, 2009, *no changes since 2007.

- Renewable Energies

There is currently no price regulation for RE products. Tax exemptions are valid for all systems of electricity generation, including wind power systems, SHS, hydro, steam and gas systems, which are all exempted from payment of import duty and VAT (§ 85.02, The Harmonized System and Customs Tariff Schedules 2007). For RE components, such as lamps and lanterns, there is a 10% import duty and 12.5% VAT are incurred (§85.36). AGSI and the Energy Commission are in discussion to standardize components so that RE parts can be differentiated from conventional parts such that they will also be tax exempted. Unlike their grid-connected counterparts, RE electricity generators (excluding the large hydro power plants at Akosombo and Kpong) are not subsidized.

A Renewable Energy Law that intends to increase the contribution of modern RE from 0.01% to 10% in the medium term (excluding woodfuel and large hydro) is currently under discussion.[12] The Energy Commission in collaboration with an international consultant developed the draft bill that aims to create an enabling environment to attract investment in renewable energy resources, encourage the use of renewable energy, diversify supplies to safeguard energy security, improve access to electricity through the use of renewable energy sources, build indigenous capacity in technology for renewable energy sources, increase knowledge and awareness of renewable energy production and consumption, and regulate the production and supply of woodfuel and biofuel.

The Law will put the financial incentives in place to develop and use RE for electricity generation by establishing a tariff regime with guaranteed technology-specific prices for each RE technology. PURC will determine the average costs and share for RE generated electricity vis-à-vis conventional based on a weighted average price that will account for economic viability for independent producers and affordability for consumers.[13] The feed-in-tariff rate will be fixed for a period of twenty years from the date of the grant of the license.

In addition, the distribution companies VRA and ECG will be mandated to purchase a specific share (as determined by PURC on an annual basis) of its total purchase of electricity from RE sources, or otherwise will be charged a premium. The licensing framework for commercial activities in the RE sector foresees the completion of the licensing process within 70 days. The Energy Commission will be mandated by law to promote the local manufacturing of RE components, to develop plans for training and supporting local RE experts, and to promote the technical benefits of biofuels. The Minister of Energy may on recommendation of the Board of the Energy Commission make regulations for the following areas:

- Rates of wheeling electricity generated from RE sources;
- Standards with regard to biofuel and electricity;
- Standards of performance and technical standards for the use of RE resources; and,

[12] MoE, 2010, http://www.energymin.gov.gh/download/address.pdf.

[13] Since PURC lacks the necessary in-house knowledge on RE, the feed-in tariff scheme is designed by an external consultant.

- Control and management of biofuel, and woodfuel, for the establishment of a scheme for the creation, trading and extinguishing of RE certificates.

As part of the GEDAP programme, the Government has committed itself to submit a renewable energy bill to Parliament by October 2010 (revised from December 2008 and December 2009). The law is now with the Minister of Energy. According to experts, the draft bill is likely to be presented to the Cabinet by March 2010, and enter Parliament before July 2010. Interview partners have acknowledged not only the enactment, but also the implementation of the law as critical.

The Law also aims to establish the Ghana Renewable Energy Fund (GREENfund) that will be managed by the Energy Commission which is preparing the detailed concept and currently discussing the specific structure. The Fund's objective is to promote the grid interactive renewable electricity by means of generation based incentives, feed-in-tariffs and capital subsidies. In addition, the Fund aims to support scientific and technological research into RE, as well as research into the establishment of RE standards and programmes to adopt international best practices.

The Fund, through inter alia subsidies and equity participation, will mainly invest in the production of RE equipment, the development of large-scale solar and wind projects and grid-connected RE systems drawing on feed-in tariffs coming with the new law. The tax-exempted Fund will be sourced by (1) the premium payable from bulk customers who do not comply with purchasing a certain percentage of their electricity from RE as set by PURC, (2) grants, donations and other voluntary contributions to the Fund, (3) any person, donor and international organization, (4) moneys specifically earmarked for the Fund, (5) internally generated funds obtained from RE related activities, (6) moneys provided by Parliament, (7) moneys that the Minister with the approval of Parliament may determine, and (8) other moneys or property that may in any manner become lawfully payable to and vested in the Board of the Energy Commission for the benefit of the Fund.

- Charcoal Production and Distribution

Compared to electricity and the petroleum sub-sectors, relatively little investment is made to formalize this traditional energy sub-sector. The sector operates as an informal sector lacking human capacity at all levels of governance to develop, implement and monitor policies on wood fuels and with poor institutional linkages among the various agencies that should be devoted to manage the traditional fuel and ensure a sustainable woodfuel industry.

The only regulations in place apply to charcoal export that has officially been stopped with regulations and an administrative order effected by the Energy Commission. Only charcoal from wood wastes and owned plantations is permitted. There is neither a price regulation authority for wood fuels nor an association of suppliers responsible for pricing. As part of the RE draft bill, the Energy Commission will in consultation with the Forestry Commission develop a reforestation programme to sustain woodfuel production.

- Biofuel

In November, 2005, the Energy Commission completed a National Bio-fuels Policy Draft, which was subsequently forwarded to the Cabinet. It still has not been presented to Parliament as a bill to pass into law. Portions of it were, however, incorporated in the 2008 Budget Statement, including fiscal incentives to be provided for investments in the bio-fuel industry such as tax-holidays of up to five years and a reduction of corporate tax from 25 to 20 percent for businesses directly related to the development of the bio-fuel industry.

As part of the RE draft bill, biofuels will be designated as petroleum product in accordance with the National Petroleum Act, 2005 (Act 691). With enactment of the RE law by the end of 2010, the National Petroleum Authority will be responsible for pricing biofuel. The proportion of biofuel in biofuel blend will be determined from time to time by the National Petroleum Authority in consultation with the Energy Commission.

- International Treaties

Ghana signed the United Nations Framework for Climate Change in 1992 and ratified it in 1995. It subsequently acceded to the Kyoto Protocol in 2002 and has been participating in sub-regional, regional and international development.

- Energy Efficiency

Ghana was the first country in Sub-Saharan Africa to enact standards for appliances, particularly room air conditioners, in collaboration with the Collaborative Labelling and Appliance Standards Program (CLASP). Today, the following regulations are in place:

- L.I. 1815: Energy Efficiency Standards and Labelling (non-ducted air conditioners and self-ballasted fluorescent lamps) Regulations, 2005, requiring a minimum EE ratio of 2.8 per Watt and 33 lumens per Watt, respectively.
- L.I. 1932: Energy Efficiency (Prohibition of Manufacture, Sale or Importation of Incandescent Filament Lamp, Used Air-Conditioner) Regulations, 2008
- L.I. 1958: Energy Efficiency Standards and Labelling (Household Refrigerating Appliances) Regulations, 2009

Under the "Energy for Growth" strategy, the power sector reform will continue with the preparation of Energy Efficiency standards and labelling for refrigerators and freezers. In 2009, the Ministry of Environment, Science and Technology conducted a survey of household electrical appliances for the development of the national refrigeration efficiency standard. An amendment to the building code is in the pipeline which will require one to make space for the erection of solar panels on the roofs of houses. In addition, the Energy Commission will work on regulating solar water heaters for commercial and public buildings until 2012.

1.4.4 Guidelines/Energy Policy

As acknowledged in the 2010 Government Budget, 'the energy sector provides one of the greatest risks to the [Ghanaian] economy'. Accordingly, the Government's overall goal for energy is the development and sustenance of an efficient and viable energy sector that provides a secure, safe and reliable supply of energy to meet the country's development needs in a competitive manner.

Due to uneconomically low tariffs and delayed payments by public institutions dating back to Q2/2009, VRA and ECG have been in constant financial crisis preventing them from maintaining and expanding the power system. As a result, VRA has accumulated debt of more than USD 800 million as of February 2010.[14] To minimize this risk, the Ministry of Finance and Economic Planning (MFEP) had undertaken a Power Sector Financial Restructuring and Recovery Study in May 2008, the findings of which were supposed to enter a Comprehensive Financial Recovery Plan for the three power utilities. However, the study has not been completed yet.

The Ministry of Energy will work with the Ministry of Finance to re-capitalize VRA, ECG and NED and ensure their long term financial viability. Power tariffs are going to increase considerably by this year to enable utilities to operate on sound financial footing.[15] The Volta River Authority, Ghana Grid Company, and Electricity Company of Ghana submitted proposals to Public Utilities Regulatory Commission for price increases (155%, 173% and 109%, respectively). The last increase dates back to 2007, when PURC granted a 35% price increase to VRA to become more efficient and prevent power outages.

Provided that commitments are met by the Government to clear arrears and indebtedness to VRA and ECG, the World Bank will disburse funds of USD 450 million to the country (USD 200 million budget support and USD 250 million for project support). To improve the availability and reliability of power, the Government of Ghana pursues both a short-term action programme and a long-term strategy. In the short to medium term, the Government aims to address the power capacity deficit and targets the installation of 5,000 MW of power generation capacity by 2015.

The anticipated increase in generation will enable cost-effective supply to meet the nation's requirements including that of VALCO. In this regard, a total of 1,611.5 MW of capacity is currently under construction by Government and Independent Power Producers while other plans have been initiated to increase power generation capacity in the country. Projects to increase power generation in the short- to medium-term focus mainly on large hydro power and thermal power, among them the 49.5 MW Tema Thermal 2 Power Project (TT2PP), the 132MW combined-cycle power project in

[14] State of the Nation Address by the President of Ghana, John Evans Atta Mills, February 19, 2010.

[15] Despite tariffs below production costs, both the President in his Address to the Nation in February 2010, and the Minister of Finance in his Budget Statement for the 2010 Fiscal Year in November 2010, argue for lowering energy tariffs by increasing efficiency of energy production (e.g. through developing gas turbines).

Aboadze, and the 125 MW Osagyefo Power Barge. The 200 MW Sunon Asogli Kpone Power Plant, which is managed by the Shenzhen Energy Group and partially financed by the China-Africa Development Fund, will provide additional 360 MW after completion of the second construction phase. The USD 600 million project is near completion and will start generating power soon provided that Nigerian gas is being delivered through the West African Gas Pipeline. In 2009, the 126 MW Tema Thermal 1 Power Project (TT1PP) which is now fully operational was commissioned. Interventions undertaken also include the construction of the 400 MW Bui Dam hydro power plant and completion of the Regional Capitals Street Lighting projects for selected streets in Accra, Tema, Kumasi, Takoradi, Ho, Sunyani, Bolgatanga and Wa.

To reform and modernize the power sub-sector, MoE has estimated investments requirements at USD 3 billion (and at USD 10 billion for the energy sector as a whole).[16] This figure includes USD 1 billion for generation development, USD 500 million for transmission infrastructure development, USD 1 billion for distribution infrastructure development, and USD 500 million for rural electrification and RE projects (solar PV, wind and mini hydro).

For the 2010 Fiscal Year, the Government is focusing on upgrading the transmission and distribution systems while scaling up rural electrification to ensure increasing access to electricity by household and industry. Against the background of several power crisis and rolling blackouts in the recent past, the Government is strongly interested in increasing electricity access, supply and reliability, in order to meet the projected rising demand for power and mitigate impediments to economic growth. As a main objective of its "Energy for Growth" Strategy, the government intends to assure an electrification rate of 75% by 2015 and universal access and choice of modern forms of energy to the whole population by 2020. Under the National Electrification Scheme (NES), grid connections will be expanded to around 950 more communities and electrification to a further 200 communities (MoE, 2009).[17] Projects to be implemented will include the extension of electricity supply to about 800 selected communities under a Supplier's Credit facility of USD 170 million by China International Water & Electric Corporation (CWE). An additional 1,200 selected communities will be financed under an arrangement by the US EXIM Bank, 200 more communities will be connected under SHEP-4. In addition, ECOWAS Bank for Investment and Development (EBID) will contribute to finance the connection of 106 selected communities in the Ashanti and Brong-Ahafo Regions, while BNP Paribas will partially finance the connection of 79 communities to the national grid in the Ashanti and Eastern Regions.[18] A Rural Electrification Agency is going to be established that will be devoted to coordinate all rural electrification programmes and to provide cost effective rural electrification options including renewable energy throughout the country, also considering off-grid solutions for potential customers that are located too far from the grid for connection to be economically viable. The responsible consultant has completed the work; however, the immediate establishment of the REA could be slowed down due to the fact that it will be in charge of grid extension, thus reducing political decision-making influence on grid extension.

The long-term strategy of the Government is the regional integration of Ghana's energy system through two multinational energy projects: the West Africa Gas Pipeline (WAGP) and the West Africa Power Pool (WAPP), which are both financed by the World Bank. The WAGP will diversify Ghana's hydro-based power system by bringing lower cost Nigerian gas through Benin and Togo to Ghana. The ongoing WAPP will enhance cross-border power trade in West Africa by strengthening interconnection lines from Côte d'Ivoire to Benin along the Ghanaian coast, and by establishing interconnection lines within Ghana to transfer thermal power northwards to the Sahel countries. Although construction of the gas pipeline finished over one year ago, and tests were concluded one year ago, the IPP are still waiting for Nigerian gas to be delivered (World Bank, 2009).

Other key elements of the Government's agenda are to add capacity at the transmission and distribution levels, open up the sector to independent power producers, pursue regional cooperation projects, strengthen the regulatory institutions, implement power sector reforms and reduce costs of electricity production to achieve lower tariffs. The Ministry is also working to improve the long term financial viability of the three power utilities. This plan will also affect full

[16] MoE, 2010, http://www.energymin.gov.gh/download/address.pdf.

[17] At the inception of the scheme in 1989, 478 communities were connected. The first phase of the NES, the National Electrification Project (NEP), electrified all district capitals as well as towns and villages along the routes to the capitals, which was completed in 2000. The second phase, the Self-Help Electrification Programme (SHEP), electrified all communities located 20km from the national grid if they pay for the required poles. Today, about 4,000 communities have been connected to the national grid. The Ministry of Energy is currently working on the development of a statistical data system that will enable them to determine the Access Rate on weekly basis.

[18] Signed contracts for increasing access to electricity also include China Water & Electric Corporation (USD 90 million), Elecnor S.A. (USD 5 million for solar), JICA sponsored West Akim Electrification Project (USD 7.6 million) and Upper Denkyira Electrification Project (USD 4.6 million), Weldy/Lamont Associates (USD 350 million), Bilpower Limited/Chrispod Limited (USD 30 million), and Eltel Networks Corporation (EUR 10 million).

transfer of the national transmission grid assets from VRA to GRIDCO, and protect assets and liabilities associated with the government sponsored Tema and Kpone thermal power projects. It is estimated that, about USD 9.0 billion is required in the next five years to finance the numerous initiatives in the energy sector, of which oil and gas activities alone require over USD 5.5 billion and USD 400 million for thermal power plants.

- Renewable Energy

The evolution of national policies relating to renewables in Ghana can be traced back to 1983 when the National Energy Board (NEB) was established. Within the last decade, renewable energy has come to play a more significant role in the National Energy Plan. The Strategic National Energy Plan (SNEP), which was developed by the Energy Commission for the period from 2006 – 2020, identifies the optimal path for the development, use and efficient management of the country's energy resources required for economic development. The plan seeks to increase the use of RE to 10% of the country's energy mix by 2020 and achieve 30% penetration of rural electrification via renewable energy technologies by 2020. To achieve this aim the plan recommends to introduce feed-in tariffs, backed by a regulatory framework that allows existing biomass co-generation plants to be connected to the national grid through issuance of licenses for large renewable energy plants, to encourage District Assemblies to provide alternative RE solutions to their off-grid communities, to investigate innovative financial schemes, including capital subsidy arrangements and micro-financing, to overcome the cost barrier to renewable energy. In the Plan, the Ghana Investment Promotion Council (GIPC) Investment Code will be asked to make provisions for tax exemptions for renewable energy manufacturing. In addition, wind powered and solar energy generating sets, plants, machinery, equipment or parts for the establishment of manufacturing facility should be exempt from import duty, VAT and excise duties. The Government should encourage Ghanaian industrialists to partner with popular brand manufacturers to set up branches of production and assembly lines in the country and support decentralized RE systems which could include arranging concessionary credits for local RE dealers, and to have public -private sector partnership in large-scale centralized power projects through shared costs. Many of these recommendations have entered the RE draft bill that is currently under discussion.

In 2009, the Government facilitated the development of an operational manual for providing matching grants to support renewable services by the private sector and supported the development of training and testing materials and testing facilities for human resource development in Solar PV in Tamale Polytechnic and Kwame Nkrumah University of Science and Technology (KNUST). Solar PV systems were installed in 75 rural health posts.

In 2010, the Government will continue to promote RET (specifically solar, wind and mini hydro), and technical training for solar PV installation and maintenance. A government programme has been initiated to install Grid-connected PV solar systems in schools, security service and health centres. In addition, the Government will implement grid-connected wind systems, complete the construction of the Tsatsadu mini hydro power plant, rehabilitate grid-connected solar system and develop a licensing and monitoring framework for the electricity industry. The setting up of a Biogas System for the New Ankaful Maximum Security Prison is about to be completed. A similar version of the Biogas System is also being constructed for several schools under the Ghana School Feeding Programme.

In order to promote and develop renewable energy systems, MoE sees the two-fold challenge of adopting appropriate measures towards reducing the initial capital cost of RE systems (and identify areas where connection to the grid cannot be economically justified), and of providing local technological support for production and maintenance of RE systems, particularly in the case of imported solar photo-voltaic (PV) systems. The Minister for Energy, Dr. Joe Oteng-Adjei is committed to speed up the process of establishing a Renewable Energy Law which would provide the legal basis for creating an enabling environment for private participation and for better incorporating RE in the national energy mix. The Ministry is strongly interested in attracting private sector investment in all aspects of Ghana's energy development. Furthermore, the Government of Ghana stimulates the development of a local biofuels industry, especially from agricultural wastes and Jatropha, supporting several small-scale initiatives, and promotes the construction of hybrid solar/wind energy systems for households to reduce the over dependence on the national power grid.

- Energy Efficiency

At the beginning of the 2000s, Ghana and South Africa had taken the lead in Africa in the implementation of energy efficiency initiatives. Ghana early developed an Energy Efficiency Policy, an elaborate energy efficiency programme and established institutions that promote Energy Efficiency in the country, the Ghana Energy Foundation.

Dating back to February 1997, the Ministry of Energy and Mines had signed a formal agreement with the US Department of Energy, paving the way for closer collaboration in energy efficiency promotion. Under this agreement, the Alliance to Save Energy and the Lawrence Berkeley National Laboratory (LBNL) began assisting the Energy Foundation on the introduction of performance standards for energy consuming appliances. Ghana was to be a test case for the introduction and implementation of standardization programs serving as model for replication in other Sub-Saharan African countries.

Apart from legislative initiatives on standards and labelling, the Government will continue the implementation of energy management and efficiency projects in public institutions and public education on energy conservation. Subsequent to the passage of the Electricity Regulations (LI 1937), the Ministry of Energy in collaboration with the Energy Commission is developing a comprehensive Energy Efficiency and Conservation Programme to minimize electricity consumed by households and industries. The programme aims to streamline existing institutional arrangements and intensify Power Factor Correction Projects for public institutions, which will be financed by the Electricity Demand Management Fund (EDMF) established by the Government. Furthermore, the Government will support the local production of Compact Fluorescent Lamps at competitive prices. A bill to ban the use of incandescent light bulbs is currently under consideration by Parliament. The Energy Commission has two programmes in the pipeline to create the financial incentives for consumers via cash coupons that can be cashed in partner banks for replacing incandescent lights and purchasing CFLs.

As part of the "Energy for Growth" strategy, ECG and NED will continue the implementation of projects that are aimed at significantly improving their operations. These include the prepayment metering expansion programme, the upgrading of the medium voltage network including the construction of additional primary substations, construction of call centres to enhance customer service operations, and the upgrading of the low voltage networks.

Despite the relative importance of the traditional fuel, the woodfuel subsector has for a long time not received much public investment and there were no major direct policies targeted at its growth and development. Market forces regulate the trade and uncontrolled demand could pose a high environmental risk to the resource base. In the late 1980's, two major programmes were instituted to address inefficient end-use devises for cooking: (1) the promotion of LPG as means of achieving energy conservation through fuel shifting, and (2) the nationwide promotion of the Ahibenso improved charcoal cooking stove, which was meant to replace the traditional charcoal stove. While the penetration rate increased considerably at the beginning, the complex production and high initial price prevented further expansion and sustainable impact. When the Ministry's funding ended by the mid 1990's, the programme was abandoned. In order to promote the transition of Ghanaian household energy consumption from traditional to modern sources of energy, the Ministry of Energy will require the National Petroleum Authority (NPA) to relaunch the national LPG programme with a medium-term view to ensuring access at reasonable prices for at least 50% of the population by 2015 to reduce reliance on fuelwood, taking into account the available gas from the oil find. In addition, the Energy Commission (EC) will be required to relaunch a sustainable wood fuels programme building on earlier programmes, some of which were supported by UNDP, to ensure that in the longer term Ghanaians without access to LPG will have access to a clean and efficient woodfuel stove, using sustainably produced wood fuels, by 2020. The Rural Kerosene Distribution Improvement Project will be continued and enhanced.

2 Market Size and Composition of the Green Business Sector

2.1 Renewable Energy (Energy Production)

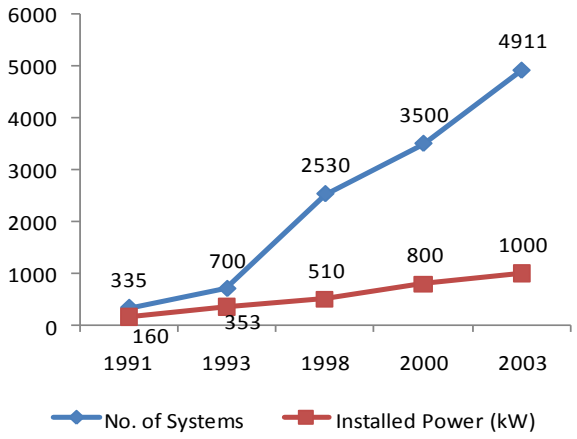
The current share of RE in the total energy mix accounts for 80% and is comprised predominantly of biomass and large hydro). The new definition, which is applied in the draft version of the RE law excludes large hydro power and traditional biomass, and defines RE as mini hydro power (< 10 MW), biomass (waste to power, excluding woodfuel), wind and solar for electricity generation. According to this definition, the current share of RE in total electricity generation in Ghana amounts to approximately 0.1% (2 MW), which is mainly generated from solar PV in areas without grid connection. Taking the enactment of the RE law into consideration, experts estimate that the share of RE in total electricity generation can realistically increase to 2 – 3% by 2012, and 20 MW by 2015 (i.e. 10% of the current 2,000 MW electricity generation).

2.1.1 Solar

- Solar PV Market

The solar market is comparatively well developed due to the nature of the technology which allows small components for installation and gradual increase, compared to other RET which are side-specific and large. Solar energy for electricity generation has been used over the years. Public solar PV electrification projects were first implemented in the early 1990's. By 1991 there were about 335 solar PV installations in Ghana with total estimated power of about 160 kilowatts. From 1991 to 2003, the number of solar PV systems increased to 4,911 systems, which is mainly a result of the National Electrification Scheme (NES) and the Ghana Poverty Reduction Strategy (GPRS I) aiming at expanding the use of solar PV in rural electrification programmes. However, in the absence of maintenance, most solar projects have not been sustainable. Another contributing factor to that stimulated solar PV installation was the energy crisis in 1997/1998 that spurred the creation of new businesses and increased competition in the market. The development of solar PV installations is depicted in Figure 4. More than 90% of the Solar PV Systems are applied in Solar Home Systems. The latest data from the Energy Commission quantify production of electricity through solar systems at 1.3 – 1.8 GWh which translate into about 140 tonnes of oil equivalent. Figures have to be taken tentatively, since they date back 5 years and are likely to underestimate the installed capacity as of to date.

Figure 4: Trend of Solar PV Installations in Ghana



Source: MoE, 2003

The development of the country's solar energy for electricity production is a credible option of relieving the energy needs of the poor. For instance, a survey of villages fitted with stand-alone SHS for lighting, radio and television between 2001 and 2002 indicated that when compared with period before the intervention: TV acquisition increased

threefold, commercial activities in the evenings increased by 30 – 50%, and emergency health cases like child delivery could be well attended to at night. Solar technologies, particularly PV systems, appear favourable for installation since it is relatively portable and simple to install and use, even though it costs more per unit electricity generated than other RE sources.

In order to overcome the barrier of high PV system costs, the fee-for-service approach was adopted by the public solar PV Electrification Projects to enable some off-grid communities to acquire solar PV systems. Hence, project beneficiaries paid only fixed monthly service fees of USD 1.63 for a 50pW and USD 2.72 for a 100pW PV system. Subsidies targeted at the poor to enable them to meet their basic electricity needs from solar PV encourage usage, sustainability and contribute to increase access to electricity services in off-grid rural areas.[19]

Table 4: PV Applications in Ghana (Dec. 2003)

Solar PV Application	No. of Installations
Solar Home Systems	4,500
Water Pumping	80
Vaccine Refrigeration	210
Telecommunication	63
Radio Transceivers	34
Rural Telephony	3
Grid-connected (50 kW)	1
Battery charging stations	20
Total	4,911

Source: Obeng/Evers, 2009

Coming from a very much subsidized approach, providing access to solar electricity as part of donor or government initiatives such as the Millennium Villages Project (and potentially distorting market prices for solar generated electricity), the solar market is now in the process of shifting to a more commercial orientation beyond high net worth individuals. The World Bank in collaboration with ARB Apex Bank and its network of rural banks is implementing a dealer/consumer model to enable low income households in underserved communities in the northern parts of Ghana to purchase SHS on a 50% subsidy, 50% loan basis (see below). Main players including DENG, Wilkins, Toyola and Wise Energy, which are all based in the capital, have been selling solar systems across the country. Under the GEDAP programme (see below), they are now providing subsidized solar systems to the low-income households in the northern part of Ghana where access to electricity will not be reached within the next 5 – 10 years.

Ghana may shortly begin local design and production of solar and other RE solutions with a new production facility started by Atlas Business and Energy Systems (ABES) and its Finnish partner Export and Import Innovations. In addition, ABES is looking into a way to introduce green loans from financial institutions geared toward low-income end-users.

Apart from this, the Catholic Diocese of Yendi in collaboration with Energiebau Sunenergy Ghana, Energiebau Germany, and Schott Solar AG Germany will install solar systems in Northern Ghana at an estimated EUR 50,000.[20] In addition, a

[19] Obeng, Evers, 2009.
[20] Alternative Energy Africa, http://www.ae-africa.com/read_article.php?NID=1455m, 18.01.2010.

solar park will be established in the northern part of the country by the Ministry of Environment, Science, and Technology to generate energy before the end of 2010. In this regard, the government is in advanced discussions with some companies in Holland and Germany to develop renewable energy sources for Ghana.

The Energy Centre at KNUST intends to make the university a showcase for generating 1 MW through solar. The project of about USD 5 million is planned to be sponsored by VRA and GEF.

- Solar Water Pumps

Water pumps in Ghana are used for domestic drinking water supply and for industrial or agricultural production, especially irrigation of land. Solar water pumps seem to have the greatest potential for future applications in Ghana compared to diesel-driven and hand-pumps, since they are less costly and more reliable than diesel-driven pumps. Small SWP systems require relatively low capital outlay, fewer skills and less equipment than the instalment and maintenance of bigger systems.[21]

- Solar Crop Drying

Solar energy in the form of sunlight is still the main energy for drying of cloths and farm produce in the country. Both natural convection and forced convection solar dryers have been field tested for the past two decades in the country and have been used for the drying of mainly crops and wood. About 17,821 tonnes of oil equivalent of solar energy was utilized in drying Ghana's cocoa and cereals production in 2004.[22] An experimental one tone capacity dryer for cereals and pepper was tested at Agona Asafo in the Central Region for two years providing evidence that the economics for large scale application of solar dryers seem to be favourable for export crops.

- Solar Water Heater

Even though, solar water heaters have been known and their potential has been tested and demonstrated over the past two decades, their market penetration in the country is still relatively low. The main problem that has limited the wider application of SWH is their high initial cost compared to electric water heaters. Nevertheless, the potential for Solar Water Heaters in Ghana is very promising, considering the projects that have been implemented especially in the tourism sector even in the absence of a building code and financial incentives. Accordingly, solar water heating is becoming an increasingly attractive demand-side management alternative since it has no fuel cost and its substantial energy savings can be used to amortise the initial purchase price of the systems. After the payback period, the savings can still be accrued over the lifetime of the system which can range from 15 – 40 years depending on the type of system and how well it is maintained.

2.1.2 Hydro

- Large Hydro

The largest RE project under construction is the 400 MW Bui Dam which is financed by a USD 562 million loan from Export-Import Bank of China. The Chinese constructor, Sinohydro, is well under way to finishing the project with electricity beginning to flow in December 2011.

In 2008, the Government also signed a memorandum of understanding with the Brazilian Government to provide a credit line of USD 500 million for the construction of two hydro electric power plants at Juale and Pwalugu in the Northern Region to generate 90 and 50 MW of power. In addition, generating capacity at Akosombo and Kpong plants could be increased by a combined 160 MW (Table 5).

Table 5: Planned Expansion of Generation Capacity (February 2009)

[21] Dittmar, Cynthia (2008), Barriers and Drivers for the Deployment of RE Technologies in Developing Countries. Case Study on the Deployment of Solar Water Pumps in Ghana.
[22] Energy Commission, 2006.

Power Generation Site	Installed Capacity	Status
Bui Hydropower Plant	400 MW	Construction: 1st unit of 133 MW to be commissioned by 2011 ending, total capacity by 2012
Juale Hydropower Plant	90 MW	Construction to start in 2010, completion by 2015
Pwalugu Hydropower Plant	50 MW	Construction to start in 2010, to be completed by 2020

Source: MoE, 2009

- Medium, Small and Mini Hydro

The unexploited hydropower potential may be in the order of 2,000 MW, of which 1,240 MW are to be developed within the short- to medium-term. The Government has identified nearly 20 medium to large hydro sites (20 – 400 MW each), and other studies have found potential for the development of 70 small hydro sites (~ 10 MW). Identified mini hydro resource sites are about 3 MW with corresponding annual generation potential of about 15 GWh.

As part of its mandate to promote the commercialization of renewable energy resources in Ghana, the Ghana Energy Foundation conducted a mini-hydro power study in 2006 to update information on the mini-hydro power sites existing in Ghana. The study revealed that (1) flow data have decreased considerably compared to 1960s due to massive deforestation and heavy run offs after rains; and (2) villages that would justify development of sites for rural electrification are either connected or close to the grid and many sites would have to be developed as grid connected plants which requires clear regulation and attractive pricing for power supply in the national electricity grid. Realistically, the quite modest mini hydropower potential in Ghana cannot make a considerable contribution to the national power requirement. This is not only due to the limited number of sites with reasonably high heads, but also due to the extremely unfavourable flow duration curves with a long dry season and high variations in river flows. The Ghana Water Company was advised to systematically review the potential for mini hydro plants on their dams and weirs, taking into consideration the recent flow data as well as the present power tariffs they have to pay.

2.1.3 Biogas

- Gasification

Based on Ghana's geography and structure of the economy generating large quantities of wood wastes (20-30% of each tree used) and structure of the Ghanaian economy generating large quantities of crop residues in the form of husk, shells from coconut and oil palm, palm nut waste and corncobs, the potential to generate power from biomass in Ghana is very high. Among the most encouraging technologies is the Combined Heat and Power co-generation based on Biomass Integrated Gasification Combined Cycle. Up to 85-90% of the energy in the fuel can be utilized.

The most significant existing biomass co-generation plants are depicted in Table 6. According to FAO projections, biomass production will increase at average annual growth rates of 2.2% and 1.8% during the periods 2010 – 2020, and 2020 – 2030, respectively.

Table 6: Identified Biomass Co-Generation Plants

Plant Location	Installed Capacity (kW)	Average Annual Generation (GWh)
Kwae Oil Mills	420	1.50
Benso Oil Mills	500	1.90
Twifo Oil Mills	610	2.10
Juaben Oil Mills	424	1.50

Source: Energy Commission, 2009.

- Methanisation

The Ghana Energy Foundation initially demonstrated the construction of a biogas latrine on campus of the University College of Education in Winneba, which was sponsored by the German Embassy in Accra. The 30 m³gas dome was designed and constructed by UNIRECO Ltd. (Accra) and is able to store 6 m³ of gas to operate a cooker for 12 hours.

For 13 years, Biogas Technologies West Africa has been operating in Ghana and across Africa, adapting the practice of anaerobic decomposition of organic matter to suit the individual client's needs. The company has developed a long track record and strong reputation in the region and across Africa, serving health and educational institutions, prisons, places of worship, recreational facilities, military and police barracks, public toilets, private households, agro-processing and food processing industries, real estate developers, hotels and restaurants. Its extensive list of clients include the Central University College, African Regent Hotel, Ghana Institute of Management & Public Administration, Jubilee House (Seat of Government & Presidency), Gushegu District Hospital, Ghana Christian High International School, African Unity Village (Cantonments), Fiesta Royale Hotel, Abdullam Orphanage (Obuasi), Abeman/Oshiuman Municipality, Accra Psychiatric Hospital, Anglo-Gold Ashanti, Children Orphanage in Prampram, Koforidua Regional Hospital, Nestle Ghana Limited, Sege-Sokorpe Municipality, Tamale Regional Hospital, Tamale West Hospital, Tema East Basic Experimental School, Trasacco Valley Estates and Valley View University. Apart from domestic projects, the company has been able to enter into contracts with such prestigious clients as UNIDO and UNEP in Zimbabwe and other UN organizations in Mozambique, Uganda and Kenya. Despite its remarkable track record and extensive experience, the company still faces challenges in obtaining financial support from commercial banks. It finances its operations by taking 60% up-front payment from clients, collecting 20% after completing 80% of the project the remaining 20 percent after testing and commission.

- Others: Waste to Energy

A waste-to-energy project was launched in May 2007 in Kumasi. The USD 136 million plant is expected to generate between 30 and 52 MW of electricity from the 1,000 tonnes of waste that are generated n the metropolis per day. The Canadian company Cinergex Solutions Ltd. is constructing the plant at Kumasi Metropolitan Assembly's (KMA) landfill site at Oti.

2.1.4 Biofuel

The available plants suitable for the production of biofuels in Ghana include oil palm, coconut, groundnut, shea nut, Jatropha, sugarcane and cassava. Today, Ghana places emphasis on the development of Jatropha as feedstock for biodiesel production. The production costs of biodiesel from Jatropha in Ghana are estimated at USD 460 per ton of oil equivalent. Currently, in Ghana over twenty companies say they are investing in biofuels, some are into the cultivation of Jatropha. In 2001, UNDP funded a plantation of some test plant species that can be used for biodiesel production. The test revealed extraordinary results as the plants had a maturation period of only 12 months (compared to maturation periods of around 3 years tested in Asian countries). In 2003, a land owner built the plant but the biodiesel

production machinery and equipment were not installed due to the financing amounting to about USD 20 million which could not be raised from Ghanaian banks, although the project is highly profitable.[23]

The first 10 tons (50 barrels) of commercial biodiesel were produced at the end of 2009 by Biofuel Africa from its 650 ha Jatropha plantation of one-year-old crops in Yendi in the Northern Region and Sogakope in the Volta Region. As such, Biofuel Africa Ltd. is the first company in West Africa to move from growing and selling Jatropha fruits and seeds to production and sale of Jatropha oil on a commercial scale for direct use, without modification, and as a feedstock for biodiesel and synthetic diesel. The Ghanaian company which is wholly owned by Norway-based Solar Harvest AS, was also the first company in Ghana to receive Environmental Protection Agency (EPA) approval for a Jatropha plantation.

The company Anuanom Industrial Projects has installed a 500-ton capacity machine for processing Jatropha seeds into biodiesel at Gomoa Pomadze (Central Region). The company has also installed a 2,000-ton capacity equipment for producing organic fertilizer from the by-product of the biodiesel.

Biosavanna Energy System, established in 2006, is dedicated to the production of biofuels from oilseeds, including Jatropha Curcas, utilising vast stretches of land in the Savannah in northern Ghana for the large-scale cultivation of Jatropha Curcas. In the initial phase, 2,000 ha were planted in Central Ghana which are planned to be expanded to 5,000 hectares.

Bio-Diesel I Ghana Ltd. operates a Jatropha oil production facility with a capacity of 2,000 tons of seeds per month in Accra. The private engineering firm Ghana Regional Appropriate Technology Industrial Services (GRATIS) is engaged in manufacturing machinery for the extraction of oil from Jatropha seeds. GRATIS currently produces oil extraction machines with capacities of 2 - 5 tons per day operating at efficiencies of 30%.

In another industrial-scale biofuels project, Northern Sugar Resources Ltd. will produce 150 million litres of ethanol per year on a 30,000-hectare sugarcane plantation. The ethanol production plant will be built by Constran S/A of Brazil on unused land in the East Gonja district of Northern Ghana. The Swedish company Svensk Etanolkemi AB (Sekab) has committed to buying the first 10 years of the plant's production. Export will start by the end of 2010 at half capacity (75 million litres). The surplus electricity generated during the processing will be sold to the Ghanaian government. Of the required USD 306 million project cost, USD 260 million is coming from a loan granted to Northern Sugar by the Brazilian Government Development Bank BNDES. The project is going to employ between 1,000 and 2,000 people. Brazil also established its first overseas Embrapa office in Accra in 2008. Embrapa is a public agriculture and livestock applied research institution with leadership in tropical agriculture, which has boosted cooperation in many areas, including on biofuels, particularly under the framework of the Pro-Renova.[24]

Caltech Ventures, an integrated industrial cassava estate in the Volta Region began the production of 10 metric tonnes of cassava flour daily for industrial use. Production on the 2,000-hectare estate between Takla and Hodzo near Ho started in 2009. The project also encompasses the installation of an ethanol production plant which is estimated to go into production in September 2010.

Furthermore, Ghana's Tema Oil Refinery (TOR) intends to go into the production of biofuels until 2011, in anticipation of the phasing out of conventional oil, its acting Managing Director has said, according to a GNA report.

2.1.5 Wind

Wind power generation systems have been spotted in the country, but are yet to be captured in the electricity balance due to lack of data. Favourable wind measurements exist at the coastline east of Accra with monthly average wind speed between 4.2 m/s (in December/January) and 5.8 m/s (in September/October) at a height of 5 m. The availability of sufficient wind is about 85%.

In the early stages of RET in Ghana, the Ghana Energy Foundation implemented demonstration projects in the country. Wind technologies have been tested in Ghana in the form of modern wind energy plants, small wind power in hybrid systems (generator or PV), and wind water pumps on small-scale for agricultural irrigation. A pilot wind pump has been erected on the coastline of the Volta Region, Anloga and operates at wind speeds between 3 and 10 m/s. With a rotor

[23] Mathias Krey, GTZ Mission Report, 2005.

[24] UNCTAD (2009), South–South and triangular cooperation in the biofuels sector: the African experience.

diameter of 1.60m, and a height of 4.50m, the pump has an estimated annual pumping performance of 3600 m³ to irrigate an area of 1 acre. Though irrigation by wind pump is clearly cheaper than the traditional methods of human labour and diesel pumping, the project has shown that a wind pump would not be competitive if the site is connected to the national grid considering the currently low level of electricity tariffs.[25]

The Swiss wind developer, NEK, plans to build a 50 MW wind farm in Prampram, at the northern coastal area 35 km east of Accra. In view of the new Energy Law, the project is now likely to receive funding from governmental institutions, as well as the required permits for its construction. In the first pilot phase, a 5 MW wind farm will be installed, which will later be extended to 25 - 50 MW, producing energy for 50,000 inhabitants (90,000 MWh). The project will be financed by their own resources, third company and partial financing by the German Development and Investment Company, DEG. The company also intends to secure funds under GEDAP. Despite the capital intensity of a wind farm, VRA considers wind energy to diversify its portfolio and to complement the country's energy needs.[26]

2.1.6 Market Trend in the RE sector

Ghana currently has a 60/40 mix of energy for electricity production from hydro and thermal sources respectively. Though long term average cost of RE may be higher than the conventional sources, diversification of energy supply will become important as climatic change impacts cause droughts and endanger the availability of hydro resources as experienced recently in Ghana or the instability of oil prices affects thermal generation costs.

Due to its extensive availability and relative low cost, it is likely that biomass will continue to dominate Ghana's energy use for the foreseeable future. However, there is a need to modernize and improve its forms of use and make its utilization sustainable in the future.

With regards to the development of small hydro and wind energy systems, the potential in the country is largely untapped. Even if the hydraulic resource is already significantly exploited, the potential remains high with an estimation of 2,000 MW of new hydro power (about 800 MW from small hydro sources).[27] For Ghana, with the daily solar irradiation of between 4 and 6 kWh/m² with higher levels in the northern regions and the annual sunshine duration of 1,800 to 3,000 hours provides an excellent opportunity for future solar energy development. On the biomass side, since the economy of Ghana is mainly driven by the agriculture sector, agricultures residues and wastes are available in a large quantity and are quite spread out country wide.

In general, market size and growth trend of RE businesses are influenced by similar factors. First, demand-side initiatives are needed to overcome high initial costs and allow affordability of RE products in order to build up the market. In this regard, there is, second, a great need for public sensitization and RE demonstration. Third, RE businesses are short of qualified human resource. And, fourth, market growth is also constrained by current legislation and reluctance of public utilities to invest into RE generated electricity. This is due to their high costs compared to the subsidized hydroelectricity and their unavailability/unreliability during peak hours, 7 – 10 p.m.

Solar photovoltaic, grid connected wind farms and bio-diesel do not compete with other energy supply options on a least-cost basis. A UN-ENERGY Demonstration Study conducted by the Department of Economic and Social Affairs (DESA), the Food and Agricultural Organization (FAO), the International Atomic Energy Agency (IAEA), the United Nations Environment Programme (UNEP), and the United Nations Industrial Development Organization (UNIDO) in 2006 compared three policy measures, (1) an RE quota, (2) a public benefit fund and (3) a CDM scenario in the Ghanaian context. The study made the following assumptions:[28]

1) Renewable Energy Quota: a minimum share obligation of RE is imposed on electric utilities, starting from 2010. The share of RET in total electricity generation has been assumed at 2% for 2010, progressively rising to 20% in 2030.

[25] Ghana Energy Foundation, 2006.
[26] Engineer Kirk Kofi, Deputy Chief Executive of the Volta River Authority (VRA) at CDM conference in June, 2009.
[27] A small hydro plant (SHP) is defined as any hydro installation rated as less than 10 MW.
[28] UN-ENERGY Demonstration Study (2006), Assessing Policy Options for Increasing the Use of Renewable Energy for Sustainable Development. Modelling Energy Scenarios for Ghana.

2) Public Benefit Fund: a fund is created through a levy on electricity transmission, which can be used for partly funding investments in RET. The study assumes that a flat rate levy of USD1/MWh on electricity transmission and that the fund finances up to one-third of the needed investment for wind and solar technologies.

3) CDM Scenario: the possibility of deploying renewable energy technologies as CDM projects under the Kyoto Protocol. A price of USD15/tonne of CO2 avoided was assumed.

The results and potential costs and benefits for the respective scenarios are illustrated in the Annex.

2.2 Energy Efficiency

2.2.1 Production

- Charcoal

Considering that woodfuel will remain the primary energy fuel for Ghanaian households, industry and commercial and service sectors over the medium- and long-term, improved charcoal production is imperative in ensuring sustainable energy supply. Depending upon quality, type of wood and type of kiln used, charcoal production requires 4:1 wood input to charcoal in the Savannah zone and 5–6:1 in the Forest zone. Almost all kilns in the country are the traditional earth mound, which is the least efficient in terms of charcoal yield. More efficient techniques could reduce the ratios to 3:1 and 4:1, respectively.

2.2.2 Transmission and Distribution

There is no private company available to provide EE. The key stakeholders in the sector are all government-owned (VRA, ECG and GRIDCO). The main actor is the NGO Ghana Energy Foundation, formerly a PPP, which pioneered EE initiatives in the country.

In order to increase collection rates, 40% of the 2 million customers of ECG will be provided with pre-paid meters by the end of 2010 (compared to currently 25%). Though collection through pre-paid meters could also increase efficiency and lower consumption, the meters are exposed to the risk of manipulation which requiring a strong monitoring and enforcement system to prevent manipulations. In addition, the ECG collection rate is already at 95 – 96% percent but still not cost covering due to uneconomically set tariffs. The only regions with positive returns are the Volta and the Central Region while the others are being subsidized.

- Industrial EE

The Energy Foundation in collaboration with its partners, such as the Ghana Association of Energy Services Companies and Consultants (GHAESCO), has been pioneering energy efficient audits for Ghanaian industries. The long list of its projects includes the Kotoka International Airport, where the Foundation constructed and installed a 5 MW capacity power station with modern power installations, energy consumption monitoring facilities, and energy saving lighting systems. Sample activities are set out in Table 6. Under the Pilot scheme, metering systems and equipment to improve power factor were installed and technical assistance was provided for 10 companies in collaboration with the International Development Association (IDA) and the International Institute for Sustainable Development (IISD), Canada.

Table 7: Sample EE Projects (Costs and Savings)

Company	Activities	Investment Costs	Energy Savings
Tema Lube Oil Company	M&T system, training and power factor correction	USD 7,034	35% over project period (~ USD 10,000)
Ghana Cylinder Manufacturing Company Ltd.	Installation of automatic capacitor banks, power factor increased from 0.68 to 0.82	Cedi 16.76 million (USD 7,023)	Electricity demand was reduced from 240 kV to 160 kV, saved 38% of monthly electricity bill in 1999 (annual savings: Cedi

			38.17 million (USD 15,946)
Ghana Textile Printing Company Ltd.	improved boiler efficiency, introduced energy monitoring system, employee education, power factor correction	Not available	6.5% of monthly electricity consumption

Source: Energy Foundation, 2007.

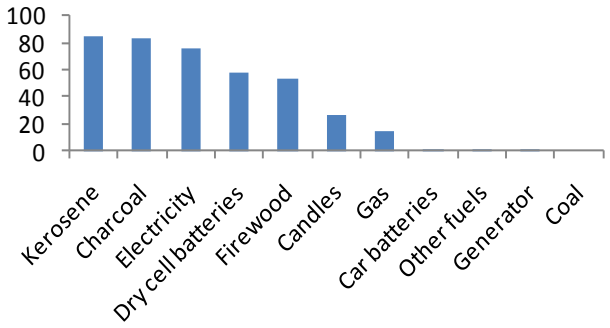
Apart from saving energy through installing power capacitors and monitoring equipment to increase power factors, industries have also shown interest in switching from diesel powered generators to natural gas transmitted through the WAGP.

- Residential and Services

The consumption landscape of Ghanaian households shows that kerosene, charcoal and electricity remain the major energy sources for most end-uses with a declining trend for fuelwood and increasing usage of charcoal (Figure 5). Most of the modern forms of energy are consumed in the urban areas. Access to electricity in Ghana is now about 64% (highest in Accra: 90%, followed by other urban areas: 72% and 23.8% in the rural areas).

The trend is similar for LPG where the penetration in the rural areas is less than 1%. The most widely used fuels for lighting are electricity and kerosene, while charcoal (51%) and fuelwood (39%) are mainly used for cooking. The higher the income the more convenient energy sources are used, making energy use an indicator of poverty. This is for instance illustrated by the selective use of electricity: 72% of households use it for lighting, but only 0.3% for cooking (0.3%).[29]

Figure 5: Fuels used by households for different end-uses (% of all households)



Source: ESMAP, 2006.

Concluding from the development of consumption patterns over time and income level suggest that fuel consumption of households is following transits from wood to charcoal and gas, in both rural and urban areas, which is due to the households' desire and ability to buy more efficient and convenient fuel for cooking. In case desirable fuels are not available or are difficult or expensive to get, households substitute them for more easily available fuels. Nevertheless, Ghanaian households of all income groups are multiple fuel users. Income does not appear to influence the number of fuels used, but it does influence the amount of fuel bought. Households with little or only irregular income buy fuels only in small quantities, i.e. the smallest amount sold, e.g. two thirds of Ghanaian households purchase a maximum of

[29] ESMAP, 2006.

300g of charcoal at a time, an amount estimated to prepare one meal. Affordability is also a barrier to ownership of electric household appliances such as refrigerators, deep freezers, air conditioners and TV. The power rating of most equipment is not high but misuse could lead to energy waste. The electrical cooker is the highest electrical energy consumer in the home with a power rating of about 8,500 watts. The gas cooker is a cheaper and more efficient alternative.[30]

Especially promising in this regard is Toyola's business model, encompassing the whole value chain of production, marketing and sensitization, retailing, and financing upstream and downstream activities for providing energy efficient cooking stoves to private households. On one side, suppliers of metal are pre-financed by Toyola through a microfinance scheme. On the other side, Toyola also offers a microfinance credit facility to enable customers to spread the payment for the stove over a longer period of time. Customers are sensitized for the product during a 3-month testing phase and ensured a guarantee of one year. In addition, Toyola gives a commission of 5% to customers who successfully market the product to neighbours. Accordingly, the company's turnover is increasing extremely fast and beyond expectations. Starting with 2,000 stoves in 2007, the company is now supplied 30,000 stoves in 2008 and is targeting 300,000 for 2010. The company is also intending to expand this business model to other countries (such as Liberia) and to other market segments such as small solar applications to private end-users and small businesses.

- Promotion of CFLs

Faced with a severe energy crisis in 2006/2007, the Government imported 6 million CFLs in 2007 that were distributed nationwide by the Energy Foundation. The Foundation planned to claim CDM revenues but could not finish the application process in time due to the urgency of the distribution. Today, the penetration rate of CFLs in Ghana is relatively high, with incandescent lights accounting for approximately 3% of all lights. A private sector initiative intends to distribute another 10 million CFLs. CFLs are mostly imported from China and exempted from import duty and VAT. A company based in Tema is also engaged in the local production of CFLs. Electricity consumption and unit costs for incandescent lamps compared to CFLs are depicted in Table 8.

Table 8: Incandescent Lamps and CFLs in Comparison

Comparison	Incandescent Lamp	Compact Fluorescent Lamp
Wattage	60 W	11 W
Service Life	1,000 hours	8,000 hours
Electricity consumption per year per bulb	263 kWh	48 kWh
Electricity cost per year per bulb	Cedis 153,200 (USD 16)	Cedis 28,100 (USD 3)

Source: Ghana Energy Foundation, 2007; Note: The comparison is based on 12 hour use per day; 1 kWh = 583 Cedis; Cedis 10,000 = USD 1.04 as of Dec 31, 2006.

[30] ESMAP, 2006.

3 Financing Green Businesses in Ghana

In this section, financing market for green businesses in Ghana is described detailing all of the different financing supply possibilities either from the government, donors or other financial institutions. Next, financial needs of green businesses are outlined and conclude with the gap between financing supply and demand, and recommendations on how to bridge the difference.

3.1 Financial Services Industry for Green Businesses

3.1.1 Government Budget and Incentives

Most interventions in the electricity sector are large scale and donor led, however the Government does subsidize the sector and plans to increase its role in financing clean energy. Financing for RE and EE development accounts for a negligible share in the national/MoE's budget. In 2009, the Government spent GHC 59.5 million (USD 41 million)[31] on energy supply (0.59% of total expenditure), of which GHC 33.9 million (USD 23.3 million, 57%) was spent on rural electrification. The energy sector received almost GHC 12.09 (USD 8.32 million) under the Multilateral Debt Relief Initiative, which represents 22% of the total amount released and was mainly used for the Self-Help Electrification Programme (SHEP-4). For 2010, SHEP-4 is projected to receive GHC 30 million (USD 20.8 million)[32] under the MDRI, which is 29% of the total MDRI funding, and additional funding from safety net programmes from the Consolidated Fund.

As outlined above, the Government is strongly interested in attracting private sector investment in all aspects of Ghana's energy development, which is reflected in the power sector reforms, the intended launch of a Green Fund which is only in the concept stage and the deregulation of the fuelwood sector. The RE law anticipates establishing competitive prices for RE feed-in tariffs. Therefore, the Government will be subsidizing all sources of renewable energy across all segments (micro, SME, corporate and project financing).

The Government has created a USD 1.6 million fund for the development of Jatropha Curcas plantations across the country. The Jatropha Implementation Committee which is chaired by the Minister of Local Government, Rural Development and Environment, released 3 billion old Cedis (USD 313.000)[33] for the production of seeds and seedlings. The remaining funds were available at local banks to be released for successful implementation of Jatropha projects in the districts. The Jatropha National Programme requires all districts and municipal chief executives and district directors of the Ministry of Food and Agriculture to ensure the successful development of about 1 million hectares of Jatropha until 2013/2014 with the objective to achieve biodiversity protection, job creation through the maintenance of Jatropha farms, production of crude Jatropha oil and biodiesel to replace fossil diesel and avoid emission of GHGs, and production of fertilizer to support the local agriculture.[34]

In 2007, the government financed the import of 6 million CFLs that were distributed nationwide by the Energy Foundation. For the 2010 Fiscal Year, the Government is focusing on upgrading the electricity transmission and distribution systems. Programmes on promoting the use of LPG and supporting sustainable use of woodfuel will be relaunched to reduce the demand for traditional biomass.

3.1.2 Development Partners (Technical Assistance and Funds)

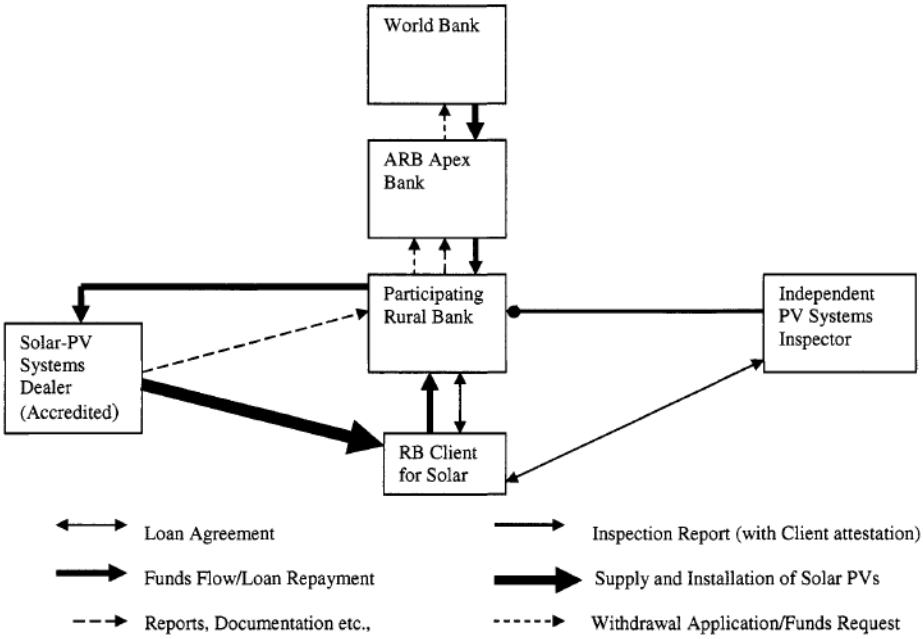
The major source of financing to the RE and EE sectors comes from grants and concessionary loans from international financial institutions focused on the Micro[35], SME and some corporate firms and primarily in solar, LPG and improving transmission and distribution systems.

[31] Exchange rates as of Dec 31, 2009.
[32] Exchange rate as of Feb 14, 2010.
[33] Exchange rate as of Dec 12, 2006.
[34] Compete (2008), www.compete-bioafrica.net/policy/countries/COMPETE-032448-NationalBioenergyPolicy-Ghana-0801.pdf (23.02.2010).
[35] For purposes of this study micro includes individual entrepreneurs as well as consumers.

- **GEDAP**

The main project among them is GEDAP, financed largely by the World Bank and other development partners, who are investing USD 210 million for sector and institutional development, electricity distribution improvement and electricity access and RE (Annex). Under GEDAP, USD 102.3 million is allocated for Electricity Access and RE including USD 9 million for introducing a new financial mechanism that combines long-term consumer credits with a capital subsidy for low-income consumers. The approach incorporates lessons learnt from past attempts of providing solar appliances to low-income households that failed mainly as a result of ownership issues (using a fee-for-service approach where the ownership for appliances remained with the supplying companies) or due to low incentives for maintenance since the project was completely sponsored by the government. Following a "dealer sales/consumer credit model", the new mechanism will consist of a tripartite agreement for the installation and maintenance of Solar-PV systems involving dealers, consumers, and the ARB Apex Bank.[36] Financing is provided to unserved households in the northern parts of Ghana through Rural Banks to acquire Solar Home Systems and Solar Lanterns. 50% of the investment costs are subsidized through a grant from the Global Partnership on Output-based Aid (GPOBA) to make solar home systems more affordable (Figure 6). The remaining 50% is given as a loan at the current market rate of 28%. Clients pay 5% of total costs as down-payment.

Figure 6: Flow of Funds for Solar PV Component



Source: World Bank (2007), Project Appraisal Document GEDAP.

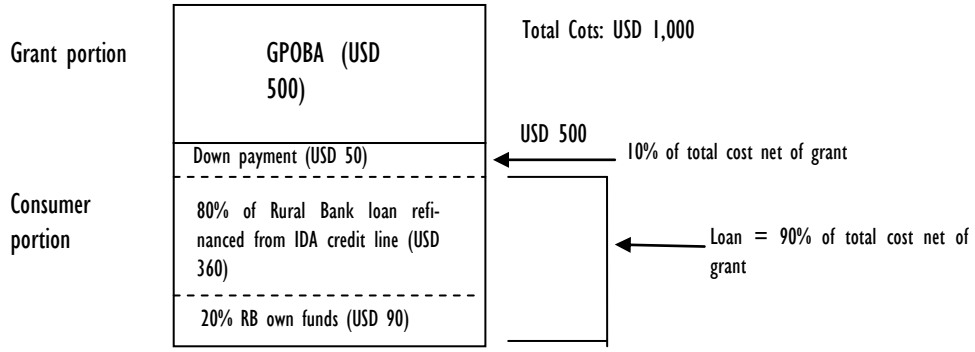
Under GEDAP, three local companies fulfilled the requirements of belonging to an association and being accredited by the Energy Commission and qualified as dealers: DENG, Wilkins Engineering and Toyola. They offer three main products to clients: (1) solar lanterns (small LED at GHC 60/USD 42, large LED at GHC 150/USD 104)[37], (2) small SHS of 10 – 49 Watt (peak) at GHC 700/USD 486, and (3) large SHS of 50 – 200 Watt (peak) at GHC 1,260/USD 874. Figure 7 demonstrates the financing sources using a 50 Wp SHS as an example with USD 1000 as total SHS cost including installation, maintenance, and battery replacement, 50% grant (USD 500), consumer down payment of 10% of remain-

[36] A designated Apex bank will manage this program and the associated project funds targeting 10,000 households in remote rural areas. According to the operational model, an established dealer in PV systems will install a Solar-PV system in rural household and following verification by the Apex bank of proper installation, the dealer will receive payment for the installation of the system and the required service that the dealer will provide. The consumer will enter into an agreement for term financing of the subsidized capital cost of the system, with a participating rural bank. The rural bank will receive the funds for the consumer credit program from the Apex bank.

[37] Exchange rates as of Feb 14, 2010.

ing cost (USD 50), and a consumer loan of USD 450 from a Rural Bank. The IDA Credit refinances 80% of the loan to rural banks (USD 360), while the rural bank provides 20% of the loan from its own resources (USD 90).

Figure 7: Sample Financing of 50 Wp SHS



Source: World Bank (2007), Project Appraisal Document GEDAP.

First sales and payments started in November 2009. As of early February 2010, more than 100 SHS were installed. Furthermore, private developers will have access to partial subsidies and long term loans of up to 50% for the development and deployment of mini-grid and grid-connected renewable energy systems.

The Project faces the following challenges:

1) Trade-off between costs and affordability: high costs for transportation and distances to conduct marketing and collection of repayments while also targeting lower interest rates;
2) Delays because of number of stakeholders involved, internal capacities have to be built up, external experts have to come in for technical appraisals;
3) Direct feedback from customers through call centre at rural bank is not being used.

The following main lessons learnt and recommendations entered the mid-term report in February 2010:

1) Exit strategy for subsidies: mid of 2011, probably earlier for solar lanterns;
2) Result-based grants for rural banks to increase efficiency;
3) Feedback mechanism: install community representative for weekly contact;
4) Increase product portfolio to 18 products (6 from each company).

Overall, the project supports the development and initial implementation of a commercially oriented framework for scaling-up electricity access. Once these models demonstrate success, they are intended to be replicated nationwide and in other Sub-Saharan African countries.

A project by the European Union aims at increasing the use of bamboo as a source of energy in Ghana providing a more sustainable, environmental friendly and economical option to charcoal and firewood for the poor. The GHC 28 million (USD 19.4 million) project is going to be implemented from March 2009-2013 and being coordinated by the International Network for Bamboo and Rattan (INBAR) in collaboration with the Government of Ghana and several partners, including the Forestry Research Institute of Ghana (FORIG), the Ghana Bamboo and Rattan Development Programme (BARADEP) and Nanjing Forestry University, (NFU), China. The project will especially consider existing government policies and proactively help in promoting sector governance issues and raising awareness of environmental aspects, such as deforestation. In order to make the intervention a successful pilot for larger scale, the project will engage with governments to bring about sector reforms which need to be sustained and extended in full co-operation with sector stakeholders, be they civil society organisations, industry or other important players.[38]

[38] www.ghananewsagency.org/s_economics/r_12676 (21.02.2010).

The USD 5 million fund managed by the Natural Resource Management Component of the Community Based Rural Development Projects (CBRDP) has been similarly accessible to Jatropha project developers since the crop helps preventing soil erosion and re-greening degraded lands.[39]

- **AREED**

The African Rural Energy Enterprise Development (AREED) program was launched in Ghana in 2000. USD 497,986 have been invested to provide seed capital for two green businesses per year. A list of invested enterprises is set out in Table 9. The programme is well-known among clean business and SME communities in Ghana and has been primarily focused on financing LPG and EE projects through KITE.

Table 9: Enterprises financed by AREED

Enterprise	Activity	Loan Size	Interest	Loan Period	Disbursement
AB Management	Power Factor Correction	USD 120,000	12%	5.5 years	2002
Gladymanuel	EE Lighting	USD 70,000	7.5%	3.5 years	2003
Anasset	LP Gas Retailing	USD 37,240	7.5%	4 years	2003
Translegacy	LP Gas Stoves Manufacture	USD 20,000	5.0%	4 years	2003
M38	LP Gas Retailing	USD 58,000	8.0%	5 years	2003
Lambark Gas	LP Gas Retailing	USD 109,746	8.0%	4 years	2004
Fee Hi Ventures	LP Gas Retailing	USD 33,000	8.0%	4 years	2004

Source: KITE, 2010.

- **E+Co**

E+Co is a public purpose investment company that empowers clean energy entrepreneurs in developing countries through business development support and investment capital provided by FMO, Norfund, GTZ and USAID. The head office is in the Netherlands but merely acts as a donor office. E+Co. served as the Fund Manager for the AREED programme but has since become independent and can now be viewed as a competitor. E+Co has investments in 15 companies ranging from those active in solar, LPG, Biomass efficient cook stoves, totalling USD 2 million. Additionally, E+Co provides a wholesale facility to an MFI. Loans range from USD 20,000 up to USD 2 million with a 6-9 month grace period at an interest rate ranging between 8-10%. In additional to debt, E+Co will provide equity or a hybrid structure and also provides enterprise development services to its clients to help with planning and networking.

3.1.3 Carbon Finance

The UNDP is currently working on mapping the energy sector in Ghana based on 'Technology Needs Assessment for Climate Change', 2009. Recommendations drawn from this document, including a programmatic instead of project approach and reduced time lag and workload for project appraisals, will enter the adjustment process for the CDM design. At the same time, the Ministry for Environment, Science and Technology (MEST) in collaboration with an international consultant is developing Ghana's Low Carbon Growth Strategy, which is estimated to be available by September 2010.

The CDM project provides a unique opportunity for project developers and other interested parties to develop the capacity to formulate and implement CDM type projects. Especially the companies that could potentially capture significant amounts from biomass waste (e.g. palm oil industry, cocoa processing and abattoirs) offer a very good CDM potential. Energy-efficiency projects leading to reduction in fuel oil and fuelwood consumption through waste heat recovery and other industrial boiler efficiency improvement measures is also promising under the CDM. In future, some of them

[39] Compete (2008), http://www.compete-bioafrica.net/policy/countries/COMPETE-032448-NationalBioenergyPolicy-Ghana-0801.pdf (23.02.2010).

might offer good potential for leveraging project implementation with CDM revenue. In Ghana, the efficient cook stoves manufactured by Toyola are to be the 1st registered CDM project in the country using ceramic to lesson emissions and monetize the benefits. E+Co, the investor in Toyola, recently signed a deal to sell its investees' carbon off-sets to Goldman Sachs but they have yet to see the revenue from their efforts to register under CDM.

3.1.4 Financial institutions

- Commercial banks

In general, banks in Ghana offer short- to medium-term loans (of up to 3 years) at high rates for LCY loans (> 25% p.a.)[40], and target mainly large corporate firms. Despite Government activities in RE technologies, financing available to businesses and consumers at commercial banks are still rare in Ghana. This is mainly a result of a low awareness and low understanding of renewable energy technologies. Banks have a nascent history in financing RE and find it difficult to enter this market.

Loans offered to RE businesses are short-term (12 months), costly and typically denominated in USD, but payable in LCY at a floating interest rate, which shifts the major risk to the entrepreneur. Thus, alternative, more flexible and immediate funding coming from informal domestic and international sources is generally preferred over banks loans. For now the kind of support banks give is on a case by case basis and still require the client, who is typically a large and long-established customer of the bank, for instance, hotels or public institutions, to pay for the RE installation. Ecobank and Calbank, for instance, have pioneered RE financing in Ghana and set up a facility to finance the installation of four biogas plants for the newly constructed student hostels at the University of Ghana. The initial estimated project cost of USD 34.3 million is financed through a USD 26 million syndication led by Calbank, with Ecobank as largest financier. The project cost has been revised upward to USD 56.3 million with a call on syndicate members to increase their commitment. Given the anticipated potential of the RE/EE market, Ecobank has been successful in direct financing of RE projects and EE financing through intermediary MFI. Apart from ARB Apex Bank, no commercial bank has a unit designated to RE finance.

Most other banks shy away from financing MSMEs in green businesses because the MSMEs cannot qualify due to the lack of a financial track record, low management know-how and poor governance structures. However, Ecobank has set out to support an NGO incubator for SMEs in green energy. In the case of financing large enterprises, for now, the kind of support banks give is on a case by case basis with existing clients such as large hotels or public institutions, whose core activities are not dependent on renewable energy technologies, but who would still largely benefit from EE measures in economic and reputational terms, especially with regard to the imminent increase in electricity tariffs. For larger project financings, the high capital costs in RET with no secondary markets coupled with the inability to provide long-term funding makes investing in these opportunities risky for commercial banks, particularly without feed-in-tariffs or little enforcements for public institutions to pay.

Therefore, participation by banks has been primarily donor driven as seen in the case of (ARB Apex and the UNEP-GCB-Ghana Telecom project (2005 – 2008) for establishing Rural Business Centres run by solar PV systems. GCB facilitated disbursement of UNEP funds as loans in GHC which were heavily subsidized at 7 – 10% p.a. for 5 to 7 years. The owner contributed 10% as down-payment. GCB was chosen after several other banks had denied interest. Ghana Telecom is also GCB's corporate client and provides the widest branch network in Ghana. As of today, only 5 out of 65 clients are meeting their repayment schedule. The project has not been as successful as envisioned for several reasons: (1) the rapid expansion of mobile phones overtook the necessity for rural centres questioning the core business model, (2) loan appraisals were largely conducted by the eCare Ghana Telecom Team, and not by GCB, and (3) GCB, though having the widest branch network, was still facing substantial operating costs for monitoring customers and recollection. Apart from eCare, GCB has no RE financing products in the portfolio. It is clear that such investments still need to be co-financed with donor or government support in order to mitigate risk and subsidize the initial upfront investments.

Financial institutions have various levels of awareness. Apart from its activities under the GEDAP program, ARB Apex Bank is also interested in financing biomass and sent a delegation to Bangladesh in order to learn from the financing

[40] As of January 2010, inflation (CPI) stood at 14.78%. The Bank of Ghana reduced its Policy Rate from 18 percent to 16 percent on February 16, 2010. Bank of Ghana, www.bog.gov.gh (accessed on February 14, 2010).

mechanisms used by the Grameen Foundation. Merchant Bank is building up capacities on carbon financing. In a pilot scheme, a solar PV was installed as back-up for one of Merchant's ATMs. The bank also finances RE initiatives within its mortgage facility. According to clients, local banks find it easier to finance new buildings with 15 – 20% targeted for RE generation equipment instead of financing solely RE.

On a national level, Ecobank seems to become the first mover to showcase commercial RE financing mechanisms. In collaboration between KITE as a technical partner, Susu collectors and the Ecobank SME unit is envisaged to design an end-user financing instrument. Ecobank has also expressed interest in financing companies in the industrial sector to switch to gas as main energy source delivered through the WAPP gas pipeline. Ecobank uses a two-fold approach for providing RE finance: (1) creating awareness about the existing benefits, and (2) providing financial assistance.

On a regional level, ECOWAS Bank for Investment and Development (EBID) provides finance to RE businesses in Ghana. Following the 2008 UNCTAD-led international workshop in Accra on the development of a biofuels industry in West-Africa, a common fund is to be set up by India's Exim and EBID. The African Biofuel and Renewable Energy Fund aims to boost biofuels production in 15 West African countries. India has pledged USD 250 million to the West African Biofuels Fund. As a first step, EBID, in conjunction with the country's commercial banks and financial institutions, provided USD 35 million for a Jatropha biodiesel project in Ghana targeting to plant Jatropha to cover about 1 million hectares of idle lands in Ghana.[41]

These emerging initiatives need to be pushed forward, and should receive more promotion to develop in-house and external awareness.

- MFIs

Currently, there are no MFIs focused on providing RE/EE specific product neither for micro and small entrepreneurs nor for consumers in the form of home improvement loans. Nevertheless, there have been several initiatives, among them:

1) Stanford project to distribute solar lighting products for USD 15 per unit on a lease basis combined with public education on RE.

2) German University to provide Jatropha cooking stoves and oil at USD 90 per unit.

Both projects failed, however, since the initial costs of USD 15 and USD 90 per unit were still too high for the targeted MFI clients. Clients were not interested in leasing the offered products since they would then be unable to service other loan repayments simultaneously to the lease payment, and also because constant maintenance services could not be provided.

As part of its agriculture portfolio, Pro Credit provides capital for solar crop drying activities used in food processing and the timber industries. In the past, Pro Credit was providing loans for solar panels/home systems but it was decided by management that these type loans represent consumer lending, an area which is not in Pro Credit's development mandate. The longest term Pro Credit extends is 5 years and for clients in the renewable energy sector, the term would be a maximum of 3 years with an interest rate around 30%.

In general, MFIs face the challenge of lacking the credit information of clients. The Ghana Microfinance Network, GHAMFIN, in collaboration with GTZ is working on developing a database to collect biometric information for preventing multiple borrowing and providing more accurate data. Another project aims at introducing a mobile saving scheme for MFIs. Since Ghana is dominantly an oral culture, clients tend to better accept voicing for new mobile services, such as daily savings. GHAMFIN is now identifying potential partner MFIs and banks to launch a pilot. It is clear that more work has to be done to realize co-financing with financial intermediaries.

[41] UNCTAD (2009), South–South and triangular cooperation in the biofuels sector: the African experience, The African Biofuel and Renewable Energy Fund (2009), http://www.faber-abref.org/fichiers/Geneva-April-2009.pps

3.2 Green Business Demand for Financial Services

3.2.1 Business Demand for Financial services

The results from the research using questionnaires and interviews conducted with real sector players in Ghana conclude that the demand for financial services from green business in all segments (micro, SME, corporate)42 and project financing is high.

- Micro-entrepreneurs: Micro real sector players, such as those vendors supplying solar panels and lanterns to consumers and some small public institutions such as health centres demand credit in order to secure enough stock. Yet the terms and conditions are cumbersome and so they typically turn to borrowing money from family and friends or using their savings.
- SME: Smaller companies are constrained in financing large and well-diversified stock or in providing the required collateral for accessing bank loans. In most cases, interest rates offered by banks to not match the business' expectations/ability to serve the interest on a profitable basis. SME real sector players such as those supplying hotels and other businesses with solar water heaters and air conditioning units demand financing to cover the initial up-front costs of procuring the equipment from overseas. Because accessing a business loan is complex and costly, SMEs use their own savings, borrowings from family and friends and even credit cards or bank personal loans.

  A Venture Capital Fund similar to the one initiated by USAID in 1991 in collaboration with CDC or the Fidelity Equity Fund to provide seed capital is a requested option by RE start-ups. Most RE SMEs started drawing on their personal savings supplemented by loans from domestic and international informal channels to start their business.
- Large Enterprise/ Corporate: Larger companies are not facing financing problems with regard to working capital (apart from the nuisance of delayed payments from public institutions) and are able to keep cash flow moving. Corporate businesses such as DENG Ltd. are more financially stable and industries such as aluminium have yet to realize the benefits from using alternative energy to power their operations. Therefore, demand is less but the main reason is because of the lack of awareness of renewable and energy efficient technologies. In Ghana, there are numerous project finance investment opportunities which would be attractive to enter drawing on the feed-in tariffs and the quota scheme provided in the forthcoming law.
- One promising area, for instance, worth funding is biofuel production, including planting, processing, transport and storage facilities. Plantations of between 50,000 – 150,000 hectares are going to put the Ghanaian market on international competitive level. Jatropha oil's low cost and ease of cultivation make it attractive for biofuel production. To mitigate the risk of low yields, pests and disease, investments should allow for trainings on improved farming techniques. Though biofuel production is still a relatively young technology in Ghana, there is a ready market for the use of biofuel, e.g. small farmers would be potential customers by using biofuel for electrification purposes and agro-processing.

3.2.2 Consumer demand for financial services

- Domestic Demand

For consumers, the cost of fuels, and in the case of electricity cost of connection, influences the choice of fuels much more than availability in the area where the household resides. Accordingly, poor households prefer to buy their fuels at neighbourhood shops with credit facilities, instead of supermarkets or petrol stations, although these credit-granting shops do not stock all fuels and in this way limit the choice of fuels. Poor households are able to access modern energy, when changes are adjusted to their payment capacity. As depicted in Table 10, although initial capital invest-

[42] For purposes of this study the following definitions apply: A microloan is a loan ranging from USD 1 – 10,000 but can also be between USD 10,000 up to USD 25,000 depending on the sector. SME loans range between USD 25,000 and USD 5 million. Corporate loans/project finance are transactions exceeding USD 5 million.

ment for the improved charcoal stove (ICS) such as Ahibenso is about three times that of the traditional charcoal stove, the total expenditure per year is comparative to the simple firewood stove. Hence, when the payment for the appliance is spread over longer periods so as to make the monthly payment amount small enough to be affordable for the poor the switch to more efficient household appliances increase rapidly. Low-income households are often excluded from normal credit facilities because they have no collateral and uncertain or irregular income. In instances where these credit conditions were lowered or waved poor households did access modern energy and appliances. In South Africa, furniture and appliance shops have credit and lay-by systems, which enable many poor households to acquire appliances. The principal payments are relatively small and spread over a long maturity.[43]

Table 10: Costs for Cooking Devices

Device	Initial Investment Cots (USD)	Total Cost per year (USD)
Three stone or mud firewood stove	0	44 – 62
Traditional charcoal stove	1.5 – 3	67 – 80
Improved 'Ahibenso'/Gyapa charcoal stove	10	37 – 43
LPG cooker (one-two burner)	30 – 50	83 – 98
Electric cooker (one-two burner)	20 – 50	81 – 93
Kerosene cooker (one-two burner)	17 – 25	138 – 161

Source: Energy Commission, 2006.

3.3 Financing barriers

As described briefly above, the provision of finance for renewable energy and energy efficiency investments is low in Ghana with wide ranging constraints. It can be easily concluded that the impact of these barriers to accessing credit is restricting growth in the RE and EE markets.

3.3.1 Barriers for Financial Institutions Investing in Green Businesses in Ghana

There are very few financial institutions with portfolios in the renewable energy and energy efficiency. The main reasons why there are very few players transacting in these areas are the following:

- Lack of Knowledge in the Renewable Energy and Energy Efficiency Sector

Potential providers of energy finance lack sufficient knowledge of the renewable energy and energy efficiency sector. Ghana is more progressive than Rwanda, however, the country still lacks qualified engineers and managers of green sector firms, and therefore banks are reluctant to trust the technical proposals and business plans.

- Nascent Market with Few Private Sector Players

While the energy sector is gradually opening to the private sector, there are still very few strong actors in the renewable energy sector. In addition, those that are active are financed through donor and subsidized funding and receive business development services to strengthen their operations and management knowledge. Financial Institutions are not keen on providing credit to a nascent market and are not in the business of providing such support services.

[43] ESMAP, 2006.

- Lack of Long-Term Capital

Financial institutions in Ghana are unable to access long-term capital at affordable rates and therefore are unable to lend long term. Few who do lend medium to long term, are typically priced out of the market, particularly for new sectors perceived as high risk.

The perceived payback period of more than 4 years for some energy projects such as hydropower is too long for existing commercial finance provides.

- Lack of Legal Framework and Subsidies

The RE law is still waiting for the approval of Parliament. Without the RE Law, the incentives for providing finance for renewable energy and energy efficiency investments is low in Ghana with wide ranging constraints.

Moreover, the banks are not able to assess the utility's capacity to purchase electricity at a determined price on a regular basis. There is no insurance in case of default. This risk is well known as national utility companies in Africa have already defaulted to pay on a regular basis.

As described briefly above, the provision of finance for renewable energy and energy efficiency investments is low in Ghana with wide ranging constraints. It can be easily concluded that the impact of these barriers to accessing credit is restricting growth in the RE and EE markets.

3.3.2 Barriers to Accessing Finance by Green Businesses

Overall, the barriers for green business to get access to finance rely mainly on the cost of loans and the amount of collateral required by banks.

- Cumbersome application process: Most businesses do not have the full management capacity to complete the application process and instead self-finance using credit cards, savings, and borrowings from family and friends.
- High Interest Rates: The interest rates on GHC loans are more than 30% on average.
- High Collateral Requirements: Even if green business succeeds to convince bank with their business plan, they are generally not able to provide the guarantee that stand as mean at around 100% of the loan
- Inappropriate Products: The product design should better address the specific needs of green businesses.
- Lack of Government subsidies: The private sector industries and consumers would switch to RET if there were financial incentives that would decrease the high capital costs of investing in RET.

4 Conclusions: Capacity Building and Financial Mechanism

Based on research and analysis, there are various mechanisms for improving the financing landscape for green business in Ghana. Alongside any financial intervention, however, there must be a component which strengthens the operational capacity of financial institutions delivering solutions to green businesses as well as to the government agencies regulating and supervising the RE/EE activities within the energy sector. Moreover, it is necessary to also develop and strengthen the institutions that are critical to the development and growth of the RE/EE sectors in Ghana (e.g. the Association of Ghana Solar Industries).

4.1 Capacity Building on the National Level

Since the costs of RE and EE measures are much more expensive than that of conventional sources, policy makers need to be convinced by tools that these increased costs can be justified (e.g. by creating jobs in the formal sector). Without government buy-in to create an enabling environment for private sector participation, the RE and EE sectors are severely constraint to expand. Capacity building measures which the Government could undertake include:

- To invest in its own human resources by addressing the technological know-how gap in RE and EE (e.g. leveraging the programmes funded by the EU for distance learning on solar and biofuels and the Partner Dialogue Facility);
- To take the lead to clearly identify all stakeholders at the top within government to ensure buy-in and educate them about RE and EE so they can set enabling policies (e.g. appropriate feed-in-tariffs, mandates for using RE and EE measures);
- To finance programmes to educate the public, demonstration and promotion of RE and EE technologies;
- To set up an information-sharing platform that portrays all activities and serves as a focal point for key stakeholders in the RE and EE sectors, and allows domestic and international financial intermediaries and real sector companies to access up-dated, comprehensive, and structured information on green business market size, trends, projects, sources of funding etc. Real sector companies should have free access to the site to be able to regularly update their profiles, thus mitigating information asymmetries, enabling financial intermediaries to better capitalize on opportunities available and avoiding duplication of efforts in mapping the sectors. A website manager would ensure quality information and regular update of the site; and,
- To facilitate the upgrading of the Association of Ghana Solar Industries to an umbrella organization to represent all green businesses.

4.2 Capacity Building on the Financial Institution Level

In order to ensure the investments in the RE and EE sectors, a technical assistance component alongside the investment is recommended to provide advisory services for the buy-in throughout the financial institution, i.e. Ecobank, as well as a return on the investment. This could include the following advisory services:

- Trainings to provide to Ecobank staff from selected departments and investors with the know-how in economical and technical assessments of investments in sustainable energy finance including certification programmes in "Renewable Energy Finance";
- RE Desk/unit at Ecobank Group and/or national level: permanent technical in-house expert(s) to be able to assess technical aspects of companies and their project track record; or
- Outsourcing technical appraisal, energy audits, and environmental impact assessments to research institutes/NGOs/consultants, such as KITE.

In order to actually realize sensitization and understanding by Ecobank staff, a holistic approach towards RE/EE Financing needs to be taken by not only offering financing solutions to green businesses and end-users but also internally

implementing a Corporate RE/EE policy and leading by example in using RE/EE in the Bank's own premises, e.g. through performance contracts with green businesses and refurbishment comparable to the Deutsche Bank Greentowers[44]. On a broader scale, sustainability should become more pronounced in the Bank's guiding principles. Clearly defined processes are needed that would make sustainability an integral part of business strategies and internal guidelines with the Management Board as main body responsible for sustainable operations. A Group Sustainability Officer could be devoted to organize and coordinate the implementation of a sustainable management system, and monitoring and optimizing the bank's sustainability program, for instance by extending the bank's sustainability-oriented products, and reducing its carbon footprint. In this regard, efforts should be made to put the institution's environmental management on a strong footing by improving the bank's environmental performance towards an international norm set by the ISO 14001 standard.[45] Upon certification, internal and external stakeholders can be assured that they are working with an environmentally responsible institution. Donor agencies, such as UNEP, could facilitate the certification process by providing their expertise and facilitate links to their certified partners.

4.3 Financing Mechanisms on the National Level

The RE and EE sectors in Ghana, even though ahead on a regional perspective, still have to grow to its full potential. In addition to the capacity building measures, it will take further initiatives from the Government for investment promotion, in particular, passing the RE Law and EE codes and offering subsidies in order to encourage participation on a large scale by the private sector. Therefore, the private sector must be supported through:

- Passing of the RE Law with market feed-in-tariff rates established and a quota scheme which will encourage IPPs to enter the Ghanaian market with RET;
- Passing a Building Code that regulates the installation of RE and EE equipment for public, commercial and private buildings;
- Introducing transparent tax breaks for the importation and manufacturing of RETs;
- Providing guarantees or concessionary loans through private/public partnerships.
- Setting incentives that encourage Ghanaian industrialists to partner with popular brand manufacturers with incentives to establish branches of production and assembly lines in the country; and,
- Financing capacity building measures by supporting the training of RE and EE human resources and research, for instance, at the DENG Solar Training Centre and Biogas Technologies West Africa.

4.4 Financing Mechanisms on the Financial Institution Level

The initial high costs of RET have been acknowledged as major barrier to their widespread deployment. Accordingly, any financing scheme has to deal with the high upfront cost of RET and in the case of most technologies maintenance and upkeep, such as with solar PV systems which incur the additional cost of replacing the balance of system components (batteries, controllers and direct current lamps). The RE and EE sectors in all segments demand flexible financing mechanisms which are absent in the Ghanaian market. The matrix below summarizes the Green Business market opportunities across all renewable energy sources and energy efficiency areas by segment (Micro, SME, and Large Entities/Corporate).

4.4.1 Micro Firms

At the micro-firm level, solar is an important RE source that offers an abundance of investment opportunities, with Ghana receiving an average annual solar radiation of 16 – 29 MJ/m², and an annual sunshine duration of between

[44] The on-going refurbishment of the Deutsche Bank headquarters will reduce electricity consumption and CO2 emissions by more than 50% and water consumption by more than 40%, making it one of the most eco-friendly high-rise buildings in the world.

[45] The ISO 14001:2004 enables an institution (1) to identify and control the environmental impact of its activities, products or services, (2) to improve its environmental performance continually, and (3) to implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating their achievement.

1,800 and 3,000 hours. Therefore, the potential for Solar Water Heaters, in Ghana is very promising, considering the projects that have been implemented especially in the tourism sector even in the absence of a building code and financial incentives. In addition, solar crop drying technologies are good investments since Ghana's economy depends to one third on the agricultural sector. As mentioned above, a tonne capacity dryer for cereals and pepper has been tested for two years and has provided evidence that the economics for large scale application of solar dryers is favourable for export crops. Solar water pumps are another cost-effective technology for Ghana's rich agricultural sector.

In the energy efficiency sector, investment opportunities exist in the improved cook stoves (ICS) and CFLs. Toyola is one such promising organisation promoting the ICS. Toyola's business model encompasses the entire value chain of production, marketing and sensitization, retailing, and financing upstream and downstream activities for providing energy efficient cookstoves to private households. On one side, suppliers of metal are pre-financed by Toyola through a microfinance scheme. On the other side, Toyola also offers a microfinance end-user credit facility to its customers. This model could remain at the micro consumer level or be easily scaled up to the SME level if financed by a commercial bank, such as Ecobank Ghana in collaboration with UNEP.

4.4.2 SME

Because Ghana has encouraged the development of SMEs through incubators and other donor led programmes, there are opportunities amongst SMEs active in many RE and EE sectors such as solar, biogas, biomass, and on a large scale, ICS and CFLs. Investment opportunities in the solar sector under micro-firms are all scalable. If the policy for incorporating solar into the building code passes, the demand for solar solutions will increase from large private sector businesses as well as from the public institutions. In Ghana, there are experienced SMEs with long standing track records such as Biogas Technologies West Africa, which has been in existence for 13 years and looking for financing to scale up their operations in Ghana and Africa as a whole. Businesses in the services and agricultural sector as well as public institutions are immediate clients to target for biogas and could be partly financed by such institutions as Ecobank. Biomass comprises the largest part of the national energy basket (76.1%) and annual production of wood residues from logging and sawmills is estimated to be around 1.1 million tonnes pointing to a large potential for biomass cogeneration from wood wastes and agriculture residues.

In terms of energy efficient opportunities, investing in Toyola's business model with the improved cooking stoves at scale can also provide additional benefits by monetizing the CDM benefits. SMEs distributing CFLs is another opportunity. Forthcoming policies by the ECOWAS Bank for Investment and Development to make CFLs in public institutions compulsory along with the Energy Commission's programme to create the financial incentives for consumers to replace incandescent bulbs with CFLs via cash coupons cashed in at partner banks is another opportunity in the EE sector.

4.4.3 Large Enterprise/Corporate

For large enterprises and corporate clients, a credit facility which provides for non-standard products allows flexibility and considers specific repayment capability, according to the renewable energy source and sector. In addition, large enterprises and corporate firms can provide end-user financing facilities or purchase agreements for energy efficient appliances to support market development, preferably subsidized with donor money.

An investment opportunity at hand can be found in Ghana's wind sector. A Consortium building wind farm which will extend up to 50 MW in capacity is interested in local financial institution participation. In view of the new Energy Law, the project is now likely to receive funding from governmental institutions, as well as the required permits for its construction. The first phase is a pilot phase which is a 5 MW wind farm. By partnering in a pilot phase with experienced wind developers, government and other international financial institutions can provide the security and learning experiences for local banks, such as Ecobank, to enter and expand their activities in the RE sector.

4.4.4 Financing Mechanism on the National and Financial Institution Levels

To accelerate the growth of green businesses in Ghana and facilitate the development of in-house capacity of financial institutions, a prototype energy fund could be established within a commercial entity, for instance at Ecobank Ghana or Ecobank group level. The Fund would provide innovative customized financing solutions to RE/EE businesses adjusted to

the types of technologies, facility owners and best practices across all segments (Micro, SME, Project and Corporate Finance).

Based on the indicative potential of achieving commercial viability in the medium to long term, initially 5-10 energy financing projects of moderate volume could be selected to provide a broad but manageable scope as a start-up. Depending on the scale, especially solar, wind and biomass projects can be considered in Ghana under the pilot funding facility. The Fund should also incorporate financing for industries to help them switch to modern, energy saving machinery and diversify their electricity consumption towards RE sources.

In addition to the energy fund, a matching technical assistance component must be provided to develop the in-house capacity of the selected commercial partner as well as of real sector companies. A third arm to this structure can be a technology institute, like KITE, which could be co-opted in as a technical partner. In order to achieve a sustainable impact, the Fund should also make provisions for the much needed post-installation maintenance services.

Strategic choices can be made on the institutional mechanisms of doing this. Options to be discussed include:

- Whether to create an energy expert unit within Ecobank on a full time basis and develop the institutional competence to deal with issues including risk assessment, business plan testing, financial projections, sensitivity analysis and stress tests specific to green businesses, while providing the mix of funds required, or
- Whether to outsource the initial technical appraisal to an external energy competence centre within an industry body or technology centre, while Ecobank conducts the financial appraisal.

Donors would be brought in on account of their contribution to the fund. Though private sector-driven, the Government should be involved and discussions with Ministries and donors on high level held from the very beginning. This could be accomplished by the government contributing a minority share to the Fund and acknowledging it as part of the government's budget or granting favourable tax conditions, yet keeping in mind that this will be a private sector led initiative and not dependent on the Government contributing funds. An alternative framework for Government participation could simply be the establishment of an Advisory Council comprised of the Minister of Energy and other stakeholders of the Fund. Either way, it is imperative to have collaboration with the Government for linkages to its own agenda in order to give the initiative proper attention and support for successful and effective implementation.

GREEN BUSINESS MARKET OPPORTUNITIES – GHANA											
	Renewable Energy						Energy Efficiency				
Loan Volume*	Solar	Wind	Hydro	Geothermal	Biogas	Biofuel	Production	Distribution	Consumption		
	PV, SWH, SWP	Pilot 5 MW Farm	Micro Hydro Power						ICS	Bio-Charcoal	Low consumption electric appliances (including industry and CFL)
Micro (Firms, Individual/consumer)	Micro-loans and Loans				Micro-loans				Micro-loans		
SME	Loan				Loans	Loans			Loans		Loans
Large Enterprise/ Corporate		Senior Credit Facility									

*Segmentation is based upon the loan volume. For purposes of this study the following definitions apply: A microloan is a loan ranging from USD 1 – 10,000 but can also be between USD 10,000 up to USD 25,000 depending on the sector. SME loans range between USD 25,000 and USD 5 million. Large Enterprise/Corporate is transactions exceeding USD 5 million.

Note: Depending on the scale, a Fund could be established which provides flexibility in offering innovative loan products and financing mechanisms adjusted to the types of technologies, facility owners and best practices across all segments (Micro, SME, Large Entities/Corporate).

Annex I

Contact List

- Business[46]

Company	Segment	Description	Contact	Phone	Mail
A.A.B. Bkm Enterprise	Solar	Wholesale supplier of alternative solar energy appliances, air cooling systems, alternative homes and buildings	Mr. Thomas Manu Kwaku	233.208.235.670	thomasmanuk-waku@yahoo.com
A & A Gas Ventures	EE	LPG gas retailing	Mr. Gilbert Koomson	0243-265619	
AB Management & Agency Ltd	EE	Local energy management firm, local contract energy manager, power factor improvement through installation of capacitor banks	Energy Foundation (Mr. Andrew Lawson)	0244768413	alawson@ghanaef.org
African Energy	Solar/wind	Wholesale supplier, exporter, system sales, specialized retail sales of solar electric and wind energy power systems and components, solar water pumping systems, solar refrigeration systems and solar controllers		1.520.720.947.5	info@africanenergy.com
Amo Gas, Abelenkpe	EE	LPG gas retailing	Mr. Amoateng	0244-762486	
Anasset	EE	LPG gas retailing	Mr. Seth Nanemeh	233.208.131.310	anasset@ghana.com
Anuanom Industrial Projects	Biomass	Processing Jatropha seeds to biodiesel	Mr. Onua Amoah (CEO)	233.216.670.16	anu-anom@internetghana.com
Arthur Energy Advisors	RE/EE consultants	RE/EE Consultancy, Development of Capital Projects, Business Strategy and Finance, Operation Modelling and Forecasting for Energy Systems, Research, Assessment and Advice, Utility Management, Company Structuring and Institutional Reform, Contract Administration and Project Implementation.	Partners: Jabesh Amissah-Arthur, Harriette Amissah-Arthur, Ruben Atekbe (Investment Banker)	233.212.700.61; 233.217.722.48	info@arthuradvisors.com
ASASE	Biomass	RE power and biogas projects in Mankoadze and Sampa	Mr. Jerry Bedu-Addo	49.622.143.322.59, 49.622.141.186.1	jbeduaddo@aol.com
Best Solar	Solar	Installation, maintenance of solar appliances	Idris Alabirah Baba	233.712.2704, 233.244.223.516	alababah@gmail.com
Beta Construction Engineers Ltd.*	Biomass	Design and construction of biogas plants	Mr. Nana Kofi Ntiamoah Ahenkorah	233.244.239.539; 233.214.041.86	betaconst@yahoo.com; kahenkorah@exite.com
Bio Diesel I Ghana Ltd. (now	Biomass	Cultivation of Jatropha	Mr. Kofi Marfu (MD)	233.243.536.778; 233.208.174.049	

[46] A comprehensive list of LPG retailers can be found on www.goilonline.com.

Company	Segment	Description	Contact	Phone	Mail
Biofuel Africa)					
Bioce Fuel Farm Ghana Ltd.	Biomass	Processing waste vegetable oil, and palm oil, plantation development, briquettes and charcoal briquettes	Mr. Romanus Gibson (CEO)	233.277.174.049	bioceff@yahoo.co.uk
Biofuel Africa Ltd. (Ghana) / BioFuel Africa AS (Norway) / Solar Harvest AS (Norway)	Biomass	Jatropha cultivation for local consumption and export	Mr. Ove Martin Kolnes	233.265.135.717	Ove@biofuel.no
Biogas Technologies West Africa Ltd.*	Biomass	Design, installation of biogas plants, import of biogas equipment	Mr. John Afari Idan	233.224.461.959; 233.272.724.040	info@btwal.com; info@biogasonline.com
Bionic Palm	Biomass	Sustainable combined oil and food plantations	Ulrich B. Riemann (MD)	233.245.310.298	info@bionic-palm.com
Biosavanna Energy Ltd.	Biomass	Production of biofuel, electricity from biomass	Mr. Seth Lokko (CEO)	233.246.721.077	info@biosavanna.com
Clean Energy (GH) Ltd.	Biomass	Retail sales, wholesale supplier, importer, consulting and installation		233.244.288.326; 233.242.156.581	
Corona Solar Energy	Solar	Design, installation, maintenance of Solar PV, SHS, solar lighting appliances, Nigerian solar electricity provider, subsidiary of Solar Energy Worldwide (UK)	Harrison Oladapo (CEO)	234.806.523.838.7	
Criterion Gold River Enterprise/Lilham Ent. Ltd.	Solar	Sales of solar PV systems and solar lighting		233.212.272.56	
Danafco Engineering Ltd.	Solar	Siemens PV products dealer		233.212.337.80	
Dawig Energie	Solar	Dealer in solar applications	David Tukuru	233.244.422.191	dawig_energie@yahoo.fr
DENG Limited*	Solar	Engineering services, RE power generation, control and transmission, manufacturer, retail sales, wholesale supplier, exporter, importer, design and installation, maintenance and repair services for solar electric (and hybrid) power systems, SWP, solar lighting, research services, Solar Training Center founded in 2005	Mr. Frede Bosteen (CEO), Mr. K.K. Cornelius (Administrative Manager)	233.212.570.99 ; 233.212.571.00; 233.212.337.79; 233.212.337.80;	fbosteen@dengltd.com; kkc@dengltd.com; info@dengltd.com
DWA Dizengoff Ghana Ltd.	Solar	Dealers in solar energy systems	David Tukuru	233.212.218.31; 233.212.118.31; 233.244.422.191;	moshe@dwa.gh.com; info@dwa-ghana.com

Company	Segment	Description	Contact	Phone	Mail
				233.212.218.15	
Ecozone	Solar	Dealers in solar PV, kits, inverters and components		233.222.146.46	info@ecozone.com.gh
Encol Limited*	Solar, Wind	Wholesale, importer, installation, engineering for solar appliances and wind energy system components, air conditions and SWH, waste treatment systems		233.249.266.932	energycol@gmail.com
Energea Ghana Ltd.	Biomass	Production of biodiesel		233.277.373.366	energeaghltd@yahoo.com
Enterprise-Works/VITA - Ghana (EWV)	EE	Manufacturing of improved Gyapa cook stove		233.212.214.06	atsu@africaonline.com.gh
F.J. Solar Technologies	Solar	Retail of solar appliances		233.208.729.205	
Fee Hi Ventures Ltd	EE	LPG gas retailing, LPG filling plant	Mr. Adu	233.277.414.112	
Fortune CP Ltd.	Solar, Wind	Manufacturer, wholesale supplier, exporter, project and system design, installation and commission for solar PV systems and components, SWH, SWP, hybrid systems, solar DC fridges, components, solar billboards, solar lighting, solar cathodic protection systems, wind turbines, solar pool heating, off-grid systems, grid-tie systems, solar air conditioners, energy audit, project financing, industrial/commercial projects,		44.132.230.3070	info@fortunecp.co.uk; sales@fortunecp.co.uk
Gladymanuel	Solar	Sales and installation of solar power systems and backup systems	Mr. Emmanuel Abbey	233.212.351.54; 233.212.504.31; 233.244.384.266	gladymanuel@yahoo.com
Gladymanuel	EE	EE Lighting products (CFLs)	Mr. Emmanuel Abbey	233.212.351.54; 233.212.504.31; 233.244.384.266	gladymanuel@yahoo.com
Global Biofuels	Biomass	Ethanol production from sweet sorghum	Mr. Otunba Felix Obada (MD)	234.014.614.397; 234.012.706.428	info@globalbiofuelsltd.com
GlobalResolve at Arizona University	Biomass	Production and marketing of gel ethanol fuel and Jatropha bio diesel around Kumasi, sustainable entrepreneurship programme	Prof. Mark Henderson	1.480.727.1062; 01.602.743.720.2	globalresolve@asu.edu
Gold Star Biodiesel Farms Ltd.	Biomass	Processing of biodiesel	Jack Holden (Executive Director)	233.208.197.938	

Company	Segment	Description	Contact	Phone	Mail
Green Energy LLC / PTL SOLAR	Solar, Wind	Manufacturing, wholesale supplying, exporters, importers of solar PV systems, components, SWP, solar lighting, solar powered advertising billboards, solar PV systems for telecommunication and custom applications, SHS and components		97.142.282.456; 97.150.105.560.0; 97.150.105.560.0	info@ptlsolar.com; dubai@ptlsolar.com
Greenfuel Biodiesel Gh. Ltd.	Biomass	Processing of biodiesel	Mr. Joseph Karam (MD)	233.243.265.450; 233.212.565.03	daniel-nashief@hotmail.com
Greenko Energy Efficiency Technologies Pvt.	EE	EE lighting products, energy-efficient solutions and technologies	Mr. Sailesh Sgatapu (Director)	91.404.030.100.0; 91.329.158.58; 91.329.468.68	info@geetech.co.in
Guangzhou Hyenergy Co., Ltd.	Wind	Supplier of wind generators (400W – 3MW)	Jason Wang (IMO)	86.203.874.370.0	
H.S. Enterprise	EE	LPG gas retailing	Mrs. Henrietta Sam	233.244.253.996; 233.208.158.289	
Hetlei Enterprise	EE	LPG gas retailing	Mr. Holeman	233.244.052.968	
Hosby Ltd	EE	LPG gas retailing	Mr. Oppong	233.277.423.331	
Jachfam Enterprise	EE	LPG Filling Station	Mr. Ben Eric Tagoe (Supervising Manager)	233.208.139.864; 233.312.273.8	jachfam2003@yahoo.com
Jatropha Africa	Biomass	Cultivation and processing of Jatropha to biofuel	Ohene K. Akoto (Director of Operations), Joseph Ofusu-Aikens (Manager for Strategic Planning)	233.207.497.594; 233.275.908.406	sales@jatrophaafrica.com
Kalten Ltd.	Solar	Dealers in solar appliances	Mr. Kwabena Koranteng Asiamah	233.216.602.22; 233.208.128.183; 233.216.722.91	kaltenltd@hotmail.com
Kemay Technology	Solar	Retail sales, wholesale supplier, importer of solar electric power systems and components, solar air heating, solar tracking systems, solar pool heating	Mr. Kenneth Asamoah	233.243.212.81; 233.246.113.28	
Kevin Power Solutions Ltd.	Solar	Manufacturing and export of backup power systems, SWH, solar lighting		91.999.990.987.2; 91.999.997.498.3; 91.972.000.205.2	info@kevinsolutions.net; sales@kevinsolutions.net; export@kevinsolutions.net
Kludjeson International Ltd.	Solar	Solarex distributor		233.212.493.32	
Kwabenya Gas Plant	EE	LPG gas retailing	Mrs. Abena Nyantekyewa	233.244.378.979; 233.288.708.970.	

Company	Segment	Description	Contact	Phone	Mail
				0	
Landmark Gas Ltd.	EE	LPG gas retailing	Mr. Adu-Mensah	233.208.135.969; 233.244.659.59	
M38	EE	LPG gas retailing			
MA TECH SOLAR (Gh) Ltd.	Solar	Sales of solar power systems, power backup systems	Mr. Michael Appoh	233.243.966.022; 233.249.140.533; 233.241.117.777; 233.271.117.777	
Madina Junction	EE	LPG gas retailing	Mr. Asafoah	233.215.107.06; 233.243.189.536	
McBryce Consultancys	RE/EE consultants	RE/EE Consulting, project development services, education and training services, research services	Michael Kottoh (Associate Consultant, consultant on the GEDAP project)	233.244.969.424	
Michikwam Gas	EE	LPG gas retailing	Mr. Ntim-Adu	233.208.152.644	
Mojo Gas	EE	LPG gas retailing	Mr. Moffat	233.208.192.548; 233.243.643.867	
Natural African Diesel (NAD) Ghana Ltd.	Biomass	Cultivation and processing of Jatropha in Pru district (BA) and Moringa, CDM PPP	Mr. Shaul Fichman	27.824.522.996	shaulenosh@hotmail.com
NEK Ghana Ltd.	Wind	Wind energy project in Prampram in pipeline (ca. 50 MW), pilot 5 MW, wind energy, geothermal energy, general renewable energy systems and sustainability, assessment and feasibility, introducing and monitoring of approval procedures, as well as technical planning and site engineering		233.212.282.14; 41.442.610.707; 41.712.440.744	nek@atlantic.com.gh; info@nek.ch; ch.kapp@nek.ch
New Energy	Solar	Retail sales, installation, construction, project development services, education and enterprise development training, environmental conservation, and renewable energy services, solar electric power systems, energy efficient lighting		233.713.086; 233.719.108.5	newenergy@africaonline.com.gh
Newlucky Electricals	Solar	Dealers in solar electric appliances		233.216.691.41; 233.242.971.338	
Northern Sugar Resources Ltd. (SEKAB)	Biomass	Sugarcane plantation and ethanol plant	Mr. Anders Frederiksson (CEO of SEKAB BioFuels & Chemicals)	46.660.751.19; 46.706.101.177	anders.fredriksson@sekab.com; info@sekab.com

Company	Segment	Description	Contact	Phone	Mail
Nortra GmbH	Solar	Retail of off-grid solar systems, esp. to schools and health facilities, installation, training courses	Alexander Bankoley (Technical Manager)	49.4461.700301	bankoley@nortra.de; biofuels@nortra.de
Nykomb Energica	RE/EE consultants	RE/EE Consultancy, energy planning and policy formulation, training and facilitation, analysis and modelling, project formulation, management and evaluation		233.244.325.852	info@energica.org
Pico Sol	Solar	Production, research, consultancy, project realisation in solar for schools, hospitals and local communities, solar PV, SWP	Henry de Gooijer (Project Manager)	31.334.650.988	pico@picosol.nl
Power Land Ltd.	Solar	Dealers in solar power and backup systems	Mr. Lawrence Nuku	233.215.035.35, 233.243.842.42; 233.212.801.83; 233.277.495.999; 233.277.455.157	goldsola@k5online.com
Power World	Solar	Dealers, installation of solar power and backup systems	Mr. Andrew Kobina Etwire	233.212.351.54; 233.208.499.98; 233.208.149.998	andrewetwire@yahoo.com
PTL Enterprise Ltd.	Solar, Wind	Retail sales, importer, system integrators, manufacturers representation, service providers for solar PV systems, solar lighting, wind turbines, LED lighting and traffic lights, RE system batteries, DC to AC power inverters	Dr. Christoph Kapp (MD)	233.214.185.31; 233.204.218.532; 233.268.243.297	
Ramboll Ghana	RE/EE consultants	Danish waste-to-energy consultancy: planning, design, tendering, construction management and commissioning	Mr. Peter Heymann Andersen, Mr. Nils Christian Holm (Heads of Waste-to-Energy Department)	233.212.415.47	peha@ramboll.dk; nch@ramboll.dk
Rich & Co. Gas	EE	LPG gas retailing	Mr. Richard Agyemang-Duah	233.242.230.562; 233.277.535.874	
RKA	EE	Manufacture LPG stoves	Mr. Vincent Yankey (E+Co)	233.244.941.895	vincent.yankey@eandco.net
SARE	Solar	Dealers, installation of solar power and backup systems	Mr. Samuel Mensah	233.244.366.077; 233.217.700.46; 233.217.640.05	saresam@hotmail.com
Scanfuel Ghana Ltd.	Biomass	Cultivation of palm oil and Jatropha, deliver off-grid solar systems to schools and health facilities, installation and training courses to local partners	Mr. Thor Hesselberg (CEO)	233.245.291.609; 47.450.035.00	th@scanfuel.com

Company	Segment	Description	Contact	Phone	Mail
Seli Technologies	Solar, Wind	Retail sales, wholesale supplier, importer of small wind turbines, towers and structures, backup power systems, solar PV, solar systems and components, energy-saving lighting and devices	Senyo T. Dake	233.277.405.512; 233.217.011.154; 233.701.115.4	selitechnologies@yahoo.com
Shacyn International Ltd.	Solar, Wind	Dealer in solar PV, solar (hybrid) systems and components, solar DC fridges, solar systems for telecom BTS stations, solar lighting, SWH, SWP, solar billboards, wind turbines, industrial/commercial projects, solar pool heating, off-grid systems, grid-tie systems, solar air conditioners, solar cathodic protection systems		233.246.698.909	sales@solarenergyghana.com
Shanghai Roy Solar Co. Ltd.	Solar, Wind	Manufacturing, export, system design, installation of solar lighting products, solar electric power systems, and components, SWP, DC To AC power inverters, solar electric charge controllers, wind turbines		86.139.175.673.67	roysolarliu@yahoo.com.cn
Sjoberg Ghana Ltd.	Solar	Manufacturing, wholesale supplier, exporter, consulting, installation, project development services, architectural design services, contractor services for energy efficient homes and buildings, solar thermal electric power systems, packaged power systems, solar lighting systems	Mr. Prosper Governor	233.244.667.528	ph.governor@gmail.com
Solar and Wind Energy (GH) Ltd.	Solar, Wind	Business development and production of solar photoelectric energy and wind turbines, new energy sources, and energy saving, urban and rural lighting projects	Ed Bossman Yeboah	233.217.682.87	edbossman@edconsultants.co.uk
Solar Electric Power Company (SEPCO)	Solar	Sales of solar electric lighting and power systems		233.217.010.182; 01.772.220.661.5	micky_mens@yahoo.com; africa@sepconet.com
Solar Electric Systems	Solar	Sales of solar PV system integrators		233.223.046.23; 233.244.255.017; 233.271.349.668; 44.208.803.280.2	info@sunrisesolarsolutionsltd.com
Solar Light Company Ltd.*	Solar	Design, system packaging, assembly, retail sales, service, import/export, engineering, installation and packaging of solar electrical systems for buildings, telecom and health appliances,	Ms. Esther Ofori, Mr. Mawuli Tse (MD), Benedette Naabeh (Ad-	233.212.343.49, 233.212.456.75	info@solar-light.com; solar@okyeame.net

Company	Segment	Description	Contact	Phone	Mail
		SWH, electrical engineering works, energy audits and efficiency consulting, LED and CFL lamps, solar PV modules	ministrator)		
Solarland	Solar	Dealer, installation of solar equipment		233.217.701.61; 233.217.845.10; 233.217.718.98	solar-land@solarlandgh.com; solarlandgh@4u.com.gh; solarlandgh@hotmail.com
Supreme Gas Ltd	EE	LPG gas retailing	Mr. Mansouri	233.244.386.703	
Sustainworld Consultant*	RE/EE consultants	RE/EE consultants, case study on Valley View University (application of biogas)	Evans Mensah Hervie	233.275.361.988	evanshervie@yahoo.com
Thaljeb Gas	EE	LPG gas retailing	Mrs. Comfort Quansah	233.244.382.049	
Tom Oil and Fat Processing Ltd.	Biomass	Cultivation of Jatropha and oil palm for biodiesel	Mr. Akwasi Anim Dankwa (CEO)	233.275.623.445; 233.244.582.027	tradexgh@gmail.com; radexgh@yahoo.com; tomoilgh@yahoo.com; aadankwah@yahoo.com
Topsun Energy Ltd.	Solar	Supplier, manufacturer of solar lighting systems, solar telecom systems, SWP, solar air cooler, solar refrigerator	Ms. Binal Sharma (Marketing), Mr. Ashit Chandaria	91.792.328.880.4	market-ing@topsunenergy.com
ToughStuff	Solar	Dealer in flexible solar PV strips, rechargeable LED lamps, mobile phone connector cables	Nick Sowden (US Director, Business Development)	261.331.276.341	info@ToughStuffOnline.org
Toyola Energy Ltd.	Solar, ICS	Production and distribution of energy efficient biomass cook-stoves and rural solar products	Mr. Suraj Wahab, Mr. Ernest Kyei	233.249.857.141	toyolaenergylt@yahoo.com
Tragimacs Sunflower Ghana Ltd.	Biomass	Processing of biodiesel for Tema Oil Refinery	Mr. Issah Sulemana (CEO)	233.208.135.861; 233.212.588.11; 233.222.511.29; 233.222.511.30; 233.208.135.861	hassi@usa.com; info@tragrimacs.com
Translegacy Ventures Ltd.	EE	LPG gas stoves manufacture	Mr. Vincent Yankey (E+Co)	233.244.941.895	vin-cent.yankey@eandco.net
UNIRECO Ltd., Accra	Biomass	Biodiesel production from sunflowers			
United Solar & Wind Power (Gh) Ltd.	Solar, Wind	Retail sales, importer of solar PV, small wind turbines, small wind energy towers and structures, tubular skylights		233.243.654.30	
Wienco (Ghana) Ltd.	Biomass	Design and construction of biogas latrine for University College of Education, Winneba	Mr. Dela Nyarko, Mr. Abdellah Nii-Commey	233.244.338.355; 233.544.331.198; 233.217.722.51; 233.217.764.47	dela@wienco.com; wienco@wienco.com

Company	Segment	Description	Contact	Phone	Mail
Wilkins Engineering	Solar	Manufacturing, design, installation, maintenance and assembling of solar systems	Mr. Omane Frimpong (President of AGSI); Mr. Boateng (Marketing)	233.244.315.634; 233.212.356.71; 233.275.001.111	wilkins@wikineng.com; sales@wilkins-eng.com; wilkins@africaonline.com.gh; Omanef@idngh.com
WISE Energy	Solar	Dealer in SHS, portable electrification, SWP, solar lighting and backup systems, owned by SARE Ltd from Ghana and the Dutch company Stroomwerk Energy BV (SWE)	Mr. Richard Collins Arku (General Manager)	233.214.031.35; 233.244.703.310; 233.208.147.775; 233.214.031.35	richarku@hotmail.com; wisenergy@ghana.com; info@wise-energy.com
*	Business interviewed				

- Financial institutions

Financial Institution	Description	Contact	Phone	Mail
ACCION International	Microfinance Institution	Ms. Ezgi Uçaner - Flor	0276-716331	eucaner@accion.org
ARB Apex Bank*	Commercial Bank, GEDAP Project	Mr. Frank Dadzie	0242270095	
DEG (German Investment and Development Corporation)	Investment and Development Corporation	Dr. Amichia J.C. Biley	0217-63942	bi@deginvest.de
E+CO Investments*		Mr. Vincent Yankey	0244941895	vincent.yankey@eandco.net
Ecobank*	Commercial Bank	Mr. Enoch Osei-Safo (Head of Wholesale)	0244-611269; 0267-611269	eoseisafo@ecobank.com
		Mr. Musa Salah (International Organisations Department)	0242-981504	msalah@ecobank.com
		Mr. Enoch Osei-Safo (Head Wholesale)	0244-611269; 0267-611269	eoseisafo@ecobank.com
		Mr. Isaac Kwei (SME)	0244238731	ikwei@ecobank.com
Ghana Commercial Bank (GCB)*	Commercial Bank, eCare Project	Mr. Justice Gaveh	0244-266282	jgaveh@gcb.com.gh
GHAMFIN*	Microfinance Network	Dr. David Andah	0217-69961	mfinet@ghana.com
ProCredit SLC Ghana*	Savings and Loans Company Ltd.	Mr. Shadrach Ellen-Koufie	0243-686405	s.allen-koufie@procredit.com.gh
*	Financial Institutions Interviewed			

- Government institutions

Government Institution	Description	Contact	Phone	Mail
Environmental Protection Agency	Public Body for envi-	Mr. William Agye-mang-	021-663451,	agyemang_bonsu@yahoo.co.uk;

(EPA)	ronmental Protection	Bonsu	021664697-8, 021-662465	epaed@africaonline.com.gh
Ghana Energy Commission*	Regulator, Standard setting	Mr. Kwabena A. Otu-Danquah (Chief RE Unit)	0277-850756	k.a.otudanquah@gmail.com; otu-danquahk@energycom.gov.gh
Volta River Authority (VRA)*	Electricity generation and transmission	Mr. Teinor Tetteh	0208140080	
Electricity Company of Ghana*	Electricity distribution	Mr. Okine	0244327511	
Ministry of Mines and Energy (MOME)*	Ministry (RE Unit, GEDAP)	Mr. Wisdom Ahiataku-Togobo	0244259407; 0208-139326	wtogobo@yahoo.co.uk; wtogobo@gmail.com
Ministry of Environment, Science & Technology (MEST)	Ministry, Development of Ghana's Low Carbon Growth Path		021-666049, 021-660005	
Public Utilities Regulatory Commission (PURC)*	Regulator	Mr. Stephen Nyante Adu	0244-316020	stephadu@purcghana.com
*	Government institution interviewed			

- Industry Bodies

Industry Body	Description	Contact	Phone	Mail
Association of Ghana Industries (AGI)*	Industry Body	Mr. Cletus Kosiba/Mr. Nat Quarcooopome	0244-382641	agi@agighana.org; ckosiba@agighana.org
Association of Ghana Solar Industries (AGSI)*	Industry Body	Mr. Samual Adu-Asare	0244-681611	info@ghanasolarindustries.com; saduasare@gmail.com
Ghanaian German Economic Association	Bilateral Chamber of Industry and Commerce		233.212.578.37; 233.212.578.38	info@ggea.net
Ghana National Chamber of Commerce & Industry*	Industry Body	Mr. Emmanuel Doni-Kwame (Mr. Amegavie was scheduled but unavailable)	0244251758; 0212-46084	doni@ghanachamber.org
*	Industry Body interviewed			

- Donors /NGO/Research

Donors/NGO/Research	Description	Contact	Phone	Mail
Canadian Parliamentary Center*	NGO	Mr. Adams Fusheini,	0243-321930	fusheinia@parlcent.ca
		Abdul Karim Mohammed	0242-948156	ohammeda@parlcent.ca;
CARE International*	NGO	Mr. Ulrich Bang	021-522465, 0244-206881	ubang@care.dk
Council for Scientific and Industrial Research (CSIR)	Research	Mr. Essel Ben Hagan		ebenhagan@gmail.com
The Energy Centre, KNUST*	Research	Prof. Abeeku Brew-Hammond, Prof. Akuffo	0246590698 (Prof. Abeeku)	abeeku@brewhammond.com

Energy Foundation Ghana*	NGO	Mr. Andrew Lawson (Executive Director)	0244768413	alawson@ghanaef.org
		Mr. Kofi Asante (Technical Director)	021-515610-12	kasante@ghanaef.org
EU Delegation Ghana	Donor	Mr. Jannik Vaa (Head of Infrastructure and Sust. Dev't. Section)	233.242.215.976, 233.244.313.352, 233.217.742.01	delegation-ghana@ec.europa.eu
KITE*	Research	Mr. Frank Atta-Owusu	0244690720	faowusu@kiteonline.net
Technology Consultancy Centre, KNUST*	Research	Mr. Michael Commeh	0244-794187; 0244-734960	kwekumichael@gmx.de
UNDP*	Donor	Mr. Martin Zwanenburg	0265-081654	m.zwanenburg@gmail.com
World Bank	Donor	Mr. Peter Kristensen	233.212.141.00; 233.21.214.111	pkristensen@worldbank.org
*	Institution interviewed			

Annex 2

Renewable Energy Project Profiles

GHANA					
RE Project	**Project Name**	**Service Description**	**Contributors**	**Beneficiaries**	**Remarks**
Solar	eCommerce and RE (eCARE)	Solar communication project: Capacity-building and financial support to 69 MSME to establish Rural Business Centres delivering clean energy-powered ICT products and services	Ghana Telecom, GCB, UNEP/United Nations Foundation (UNF)	Rural entrepreneurs, ministries, NGOs, CBOs and policy makers, peri-urban and rural customers	Since 2005
Solar	Human Resource Development for Photovoltaic Systems	Develop personnel for maintenance of photovoltaic systems at the regional level	Japan International Cooperation Agency (JICA)	Practical trainers, field workers (electricians and repairers), and laypersons at the community level	2008 - 2010
Solar	Affordable Lighting for All (ALFA)	Making lighting products and services accessible for the poor Development of microfinance models with the MFIs	Dutch Ministry of Foreign Affairs	African communities, MFIs and policy makers	2008 – 2010
Solar	Lighting Africa	Provision of reliable non-fossil fuel lighting products to unserved areas in Sub-Saharan Africa	World Bank, IFC	Entrepreneurs and businesses, Community Based Organizations (CBOs) and NGOs	Since 2009
Solar	Millennium Villages Project	Access to electricity via solar	Wilkins Engineering		
Solar		PV Refrigeration, Lighting, Water Pumping and Heating, equip rural or small health sectors with reliable technologies	Danida/MOH Solar Project		
Solar		Small-Home-Systems (SHS), battery charging, water distillation	CIDA-UR/KNUST Renewable Energy Project		
Solar		Off-grid solar electrification to villages, establishment of RE-based rural energy services company,	MOME, VRA/NED, UNDP/GEF		GEF grant of USD 2.5 million, GoG USD 0.5 million
Solar		2 solar service centres financed through a syndicated loan by IDA, ORET of Netherlands, DANIDA, Nordic Development Fund (NDF) and Caisse Française de Développement (CFD)	MOME		USD 185 million
Solar		Solar Battery Charging Centre (2.1 kW), battery operated home systems	MOME	Wachiau community	
Solar		Off-grid solar electrification of financed through a of the	Spanish Government/MOME	10 villages	Concessionary loan of USD 5 million

GHANA					
RE Project	**Project Name**	**Service Description**	**Contributors**	**Beneficiaries**	**Remarks**
Solar		Installation of Solar Service Centres (SSC)	CIDA, University of Regina and KNUST	rural communities	since 1995 financed through CIDA and University of Regina and KNUST
Solar	Small Grants	GEF Small Grants Project and Women's World Banking micro-credit scheme	Ghana Solar Energy Society (GHASES), GEF, Women's World Banking		
Solar	Rural Electrification by RE sources	Master Plan studies for rural electrification utilizing RE, identification of widespread policy and organizational problems, design of TA Technical and non-technical assistance for village development Technical transfer in solar power	Japan International Cooperation Agency (JICA)	Rural communities	2005 - 2006
Solar	Development of Energy for Poverty Reduction Action Plan (EPRAP) for Ghana	Development of Energy for Poverty Reduction Action Plan (EPRAP), establishment of database of energy projects in Ghana, monitoring and evaluation framework	UNDP through Global Village Energy PARTNERSHIP (GVEP)	Policy makers, ministries, national and international agencies, NGOs and community organisations	2004 - 2006
Solar	Rural Electrification Master Study	Master Plan Study on Rural Electrification using RE sources in Northern Ghana, financing Distribution System Master, GIS Mapping, certification of Solar-PV equipment and installation	JICA		USD 5 million
Rural Electrification		Study on the institutional arrangement for rural electrification	AFD	Researchers	Findings entered GEDAP
Rural Electrification		Anti-poverty program for Ghana, including rural electrification under the infrastructure package	US Millennium Challenge Account (MCA)		USD 547 million
Rural Electrification		Rural electrification	Indian Export-Import Bank		USD 15 million
Rural Electrification		(1) Rural electrification, USD 81 million, (2) Pre-payment meters for ECG, USD 57 million	China Exim Bank		
Solar/wind	Solar and Wind Energy Resource Assessment	Solar and Wind Energy Resource Assessment	UNEP/NREL/GEF		

GHANA					
RE Project	**Project Name**	**Service Description**	**Contributors**	**Beneficiaries**	**Remarks**
Solar		Installation of Solar PV Systems in public buildings	Spanish Government	Schools, clinics and police stations in remote rural areas	USD 5 million
Solar		Financing for rural electrification	Government of the Netherlands (through Oret.nl)	Rural population	
Solar Crop Drying	AREED	Loan for 100 solar crop dryers	AREED	Small enterprise engaged in processing and marketing of cereal and tuber food products to buy 100 solar crop dryers to increase production	
Solar Crop Drying		Solar Thermal Project to dry crops	MOME		
Biofuel	Facilitating the Provision of Sustainable Energy and Environment for Rural Development (FAPSEED)	Design and building of biomethanisation plant for processing of effluent from palm oil processing facility Design and building of 126 kW power generating biomethanisation plant methane derived from palm oil waste	European Commission, Ghana Oil Palm Development Company (GOPDC)	Communities in Koka, Afunya, Mintabomeng 50 local entrepreneurs to benefit from business development and skills training	2007 - 2012
Solar Water Pump	Solar Pump Project	Radial flow centrifugal water pump	KNUST, GTZ		
Energizing Rural Development Using Multi-functional Platforms (MFP)		Install MFPs in the Northern and Brong-Ahafo Regions, build capacity through Functional business management trainings	Heritage Savings Trust Fund (HSTF), Government of Japan through United Nations Office for Project Services (UNOPS) in Dakar	Communities in Brong-Ahafo and Northern Regions, technical and commercial service suppliers	2005 - 2008
RE	AREED	Seed capital for green business; Business development technical support	UNEP, UN Foundation, KITE,	Local entrepreneurs and	Since 2000

GHANA					
RE Project	**Project Name**	**Service Description**	**Contributors**	**Beneficiaries**	**Remarks**
			E+Co	businesses	
RE/EE	E+Co West Africa Modern Energy Fund	Investment Fund to invest USD 12 million in clean energy SMEs Effects of USD 12 million Fund: 3 million people to get access to energy, 2 million tons of CO2 offset (annually), third party mobilization: USD 120 million	E+Co, GEEREF	76 clean energy SMEs in Ghana, Mali and Senegal	2007 - 2009
RE	Renewable Energy Policy for Climate Change Mitigation	Prepare RE policy and regulatory frame-work for Ghana, draft RE Law Timely analysis of RE resources, data and review of plans through geographic information system (GIS) leading to more accurate techno-economic analysis that will result in realistic cost-benefit projec-tions Develop tools for decision making to stimulate policy initiatives designed to attract public and private investment in the RE sector, and to shorten the time required to take an investment decision through an independent confirmation of the RE source	Renewable Energy & Energy Effi-ciency Partner-ship (REED), Implementing agency: Energy Commission	Regulatory	Budget: EUR 92,200
RE	Bundling Small Scale Energy Projects for Clean Development Mechanism (CDM)	Assessment of practicalities, costs, benefits and framework requirement for small-scale RE and EE projects for CDM, case studies	IT Power	Private sector developers, organizations, bankers and investors	2001 - 2002
RE	Knowledge Networks for Sustainable Energy in Africa Project (KNSEA)	Create a digital knowledge recourse base on sustainable energy, provide statistics on energy production and use and performance indicators for energy institu-tions	World Bank Regional Pro-gramme for the Traditional Energy Sector (RPTES) Local partner: KITE	Private sector developers, policy makers, research-ers	2001 - 2002
RE	Renewable Energy Technologies (RETs) Project	Evaluation of Ghana's experience in the development, utilization and promotion of RETs: barriers and opportunities, policy recommendations, EE: charcoal and firewood production, cooking devices, RE: productivity and use of existing bio-energy resources (esp. biomass), pro-grammes of forest regeneration and afforestation.	DANIDA in partnership with UNEP	Policy makers and RE entrepre-neurs	1999 - 2001

Annex 3

Energy Efficiency Activity Profiles

EE Project	Contributor	Category	Description
Outreach Programmes	Ghana Energy Foundation (EF)	Promotion	Energy Festivals and Community Energy Durbars on energy and fuel conservation, distribution of brochures, flyers, partner programme with Traditional Authorities
National CFL Exchange Project	Ghana Energy Foundation	Promotion	Free distribution of 6 million CFLs to the public, importation by GoG, public education campaign on the programme, exchange of one for one of the CFL with installed incandescent lamps, accounting and destruction of retrieved incandescent lamps, replacement of fluorescent lamps at security agencies with energy efficient T5 fluorescent lamps
Public Education	Ghana Energy Foundation	Promotion	Calculate Electricity Bill online, Distribution of 100,000 copies of "Fuel Wise" Brochure in 2004 and publication in national papers, radio interviews on local FM stations, 3-month "Let's talk Energy" programme sponsored by the Ghana Oil Company (GOIL) on Unique FM
Saving Energy Study	EF in collaboration with University of Winneba and International Institute for sustainable Energy (Canada)	Promotion	Training students in identifying and implementing energy conservation measures in selected households , households were educated on housekeeping measures over a period of eight months, CFLs were introduced, average reduction of energy consumption of 26.4%
Sustainable Energy Management Training	EF in collaboration with Future Energy Solutions UK and British High Commission in Ghana	Promotion	Training Programme for 200 managers from public service, industry and commerce, objective: enable participants to make informed decisions on EE investments 5 modules: Energy Management Options, Energy Management Solutions for Buildings, Energy Management Solutions for Industry, Business Case for Energy Projects, Renewable Energy
Energy Management Clubs in Educational Institutions	Ghana Energy Foundation (EF)	Promotion	Launch of Energy Management Clubs at Kumasi Polytechnic, KNUST, and second cycle institutions, sensitize students on energy conservation through for a with the aim of behavioural change
Policy Advocacy	Ghana Energy Foundation and Ghana Standards Board with financial assistance from UNDESA	Regulation	Standards and Labelling for common household appliances, 1998 – 2005, scope: air conditioners and CFL to meet minimum energy efficiency ratio (EER), efficiency labels, stakeholder workshop for major appliance importers in Oct. 2004, public education campaign on standards programme financed by British High Commission and Ministry of Energy
EE in Public Buildings	Sponsors: Government of Ghana with Royal Netherlands government, implementer: Ghana Energy Foundation	Promotion	Retrofit 21 government buildings with EE electrical devices and equipment (1998 – 1999) MoU under the Activities Implemented Jointly (AIJ) of the UNFCCC, energy audits led by NIFES Consulting Group of the UK; supply, installation, commissioning of approved EE electrical equipment, lighting fittings and control devices, educational campaign of ministries' staff, power factor improvement, e.g.: Ministry of Mines & Energy saved 14% of total energy consumption
Energy Management at Tertiary Institutions	Sponsor: GoG, Implementer: Ghana Energy Foundation, Executor: AB Management & Agency Ltd	Promotion	Demonstration of energy conservation projects, installation of Capacitor Banks on the power systems of University of Ghana, KNUST, University College of Cape Coast, University of Education (Winneba), and GIMPA in 2006, Average saving: 250 million Cedis per month in electricity bills (27.2 USD as of March 2006), Project cost: Cedi 1.9 billion
Energy Audit at Volta Hotel, Akosombo	Ghana Energy Foundation	Regulatory	Energy saving opportunities: replacement of air conditioning system, conversion of electric to SHS, installation of capacitor banks for power factor correction, replacement of electric cooking range with gas-fired units

EE Project	Contributor	Category	Description
LPG Distribution for cooking	AREED	Promotion	AREED supports local enterprise in setting up rural LPG distribution centres by finalizing business plan, designing financing mechanism, providing working capital, identifying local sources of capital and providing guarantee to establish a credit line with local bank
ESCOs		Promotion	Development of Energy Service Companies (ESCos)
Green Coal Project			Improved techniques for charcoal production
LPG	USAID	Regulatory	TA for the development of rules and regulations for the operation of the secondary gas market
LPG Substitution Project	UNDP, Government of Ghana, NewEnergy	Promotion	Promote new cooking stoves and LPG, replace 80-90% of beneficiaries' use of fuelwood with LP Gas, investment in locally-produced cookers, TA, maintenance support Beneficiaries: Rural population, local LP Gas Users Association in Savelugu district 2004
Energy Efficiency in Sawmills Project	Department for International Development (DFID)	Promotion	Assessing energy utilization in the timber industry to identify appropriate technologies and processes for EE; Beneficiaries: Entrepreneurs in the timber industry, policy makers, utilities; 1999 – 2001

Annex 4

Donor Projects

- UNDP

Project Title	Duration	Costs (USD)	Funds	Description	Partners
Institutional support to integrate Climate Change adaptation and Disaster Risk Reduction into national development plans	Jan 09-Dec 09	650,000	Target resource assignment from the core (TRAC)	▪ Strengthen capacities among key institutions; ▪ Harmonize policies and practices to manage climate change and disaster risks; ▪ Prepare Ghanaian delegates for international conferences on climate change.	EPA (Mr. William Agyemang-Bonsu), NADMO (Mrs. Eunice Osae)
Expanding Access to Energy Services for the poor	Jan 09-Dec 09	100,000	TRAC	▪ Develop a District Sustainable Energy Utilization Plan for Northern Ghana, enforce regulations at local level for the development of the LPG sector ▪ Develop knowledge and effectiveness in the national/district energy plans and programmes ▪ Up-scaling strategies for delivering rural energy services	New Energy (Mr. Amadu Mahama)
Enabling Activities for Ghana's 2nd National Communication to the UNFCCC	Jan 06-Dec 09	405,000	GEF	▪ Continuation of national communication (1996-2000) and enabling activities phase II (2000-2002); ▪ Strengthen capacities for implementing the UNFCCC; ▪ Addresses data gaps and enhance awareness	EPA (Mr. William Agyemang-Bonsu)
Finalization of the National Climate Change Adaptation Strategy	June 09-Dec 09	150,000	UNEP-UNDP (Government of Denmark)	▪ Finalizing the zero draft National Climate Change Adaptation Strategy	EPA (Mr. William Agyemang-Bonsu)
Establishing an Effective and Sustainable Structure for Implementing Multilateral Environment Agreements	July 09-June 12	475,000	Global Environ-ment Facility (GEF)	▪ Merge all existing management structures at national level into one structure; ▪ Provide support to five pilot districts, in order to build national level capacity; ▪ Increased efficiency will attract additional investors to support Ghana in meeting Rio Convention obligations.	EPA (Mr. William Agyemang-Bonsu)
Climate Change Adaptation Programme	July 09-June 12	2,580,000	RBA (Government of Japan)	▪ Promote systemic change for a more integrated and holistic approach to climate change adaptation; ▪ Mainstream pro-poor and gender sensitive climate change adaptation into its national and sub-national development processes; ▪ Leverage additional adaptation funding; ▪ Improve observation and early warning systems	EPA (Mr. William Agyemang-Bonsu)
Integrating climate change into the management of priority health	Jan 10-Dec 12	1,718,182	GEF	▪ Strengthen technical capacities to manage climate change-resilient health risks; ▪ Mainstreamed risk into decision-making at local and national health policy levels; ▪ Information management and effective	EPA (Mr. William Agyemang-Bonsu)

Project Title	Duration	Costs (USD)	Funds	Description	Partners
risks in Ghana				dissemination of climate change health risk knowledge	
Promoting EE of refrigerating appliances and transformation of the refrigerating appliance market in Ghana	Jan 10-Dec 12	1,722,727	GEF	▪ Reduce energy waste and transform the Ghanaian market toward efficient refrigerating technologies; ▪ Introduction and enforcement of minimum energy performance standards and labels for refrigerating appliances ▪ Introduction of a rebate scheme for higher efficient appliances and old refrigerator turn-ins for scrapping ▪ Partnership with the private sector (appliance industry, scrap dealers)	Energy Commission, Mr. Alfred K. Ofosu-Ahenkorah

- World Bank

Project	Approval Date	Closing Date	Project Cost (USD)	Financier	Borrower	WB Contact
One Child One Solar Light	30 Dec 2008	29 April 2010	240,000 Grant	Trust Funds	Solux E.V.	Dana Rysankova
Solar PV Systems to Increase Access to Electricity Services in Ghana	10 Oct 2008	31 Dec 2012	4.35 million Grant	Global Partnership On Output-Based Aid	Government of Ghana	Richard H. Hosier
Ghana Rural Energy Access47	26 Jul 2007	30 Nov 2012	5.5 million Grant	Global Environment Facility (GEF)	Government of Ghana	Sunil W. Mathrani
Ghana: Energy Development and Access Project	26 Jul 2007	30 Nov 2012	210.55 million of which 90 million IDA loan	Consortium	Government of Ghana	Sunil W. Mathrani

Source: World Bank.

[47] Including Contract on "Preparation of RE Policy and Regulatory Framework and RE Laws for Ghana", signed 2 Oct. 2008 with PWC Gh Ltd.

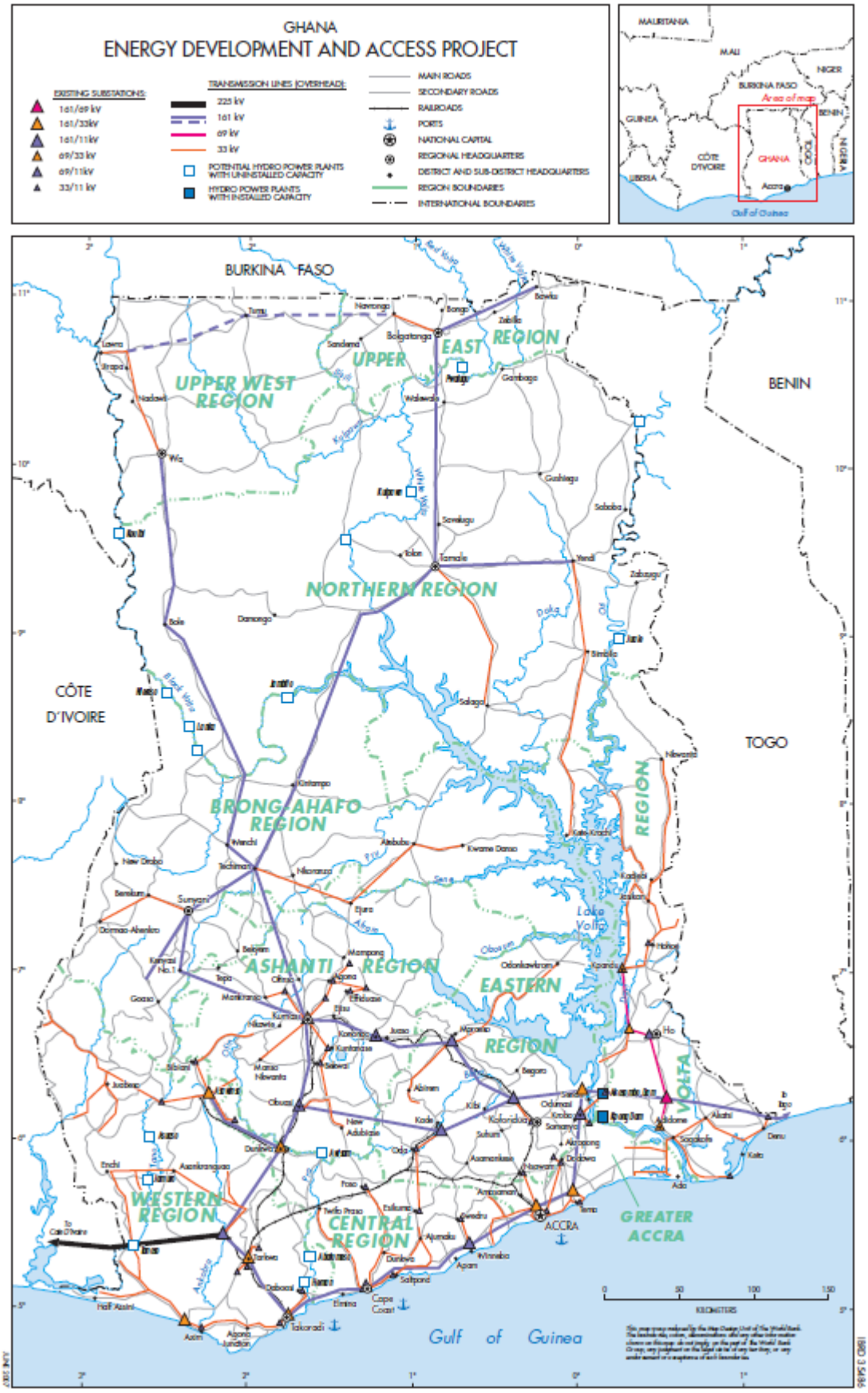
Annex 5

GEDAP*

* The Ghana Energy Development and Access Project (July 2007 – November 2012).

1 Sector and Institutional Development (USD 14 million)
▪ PURC: to improve the financial performance of the power sector, including an effective electricity tariff regime, and development of a tariff scheme and standardized power purchase agreements for RE ▪ MoE: to develop a competitive framework for attracting Independent Power Producers ▪ ECG and VRA: to establish a performance contract between the companies and the Government ▪ ECG: to design, implement, and monitor the new Renewable Energy Law, including financial incentives, and conducting RE resource assessments and promote biomass fuels ▪ EPA, MoE, and VRMNED: ensure transition from consultant-provided capacity to in-house permanent capacity ▪ The Interim Access Secretariat / REA: to plan and implement a program for increasing access to electricity
2 Electricity Distribution Improvement (USD 94.4 million) financed by IDA, AfDB, ACGF and ECG
▪ Investments in infrastructure to upgrade the ECG's distribution system, thus reducing system interruptions and outage times as well as lowering technical and commercial losses ▪ Construction of eight new 33/11 kV substations along the feeders, construction and strengthening of bulk supply points, upgrading of existing substations, construction of 11 kV connection lines, and partly reconfiguration of Low-Voltage Distribution System into a High-Voltage Distribution System (HVDS) in peri-urban areas of Accra which might later be replicated by ECG ▪ Improve revenue cycle management with better metering and testing, establish 15 customer service and call centres, replace faulty meters, install pre-payment meters in the Western, Central and Volta regions, and extend the SCADA and information technology (IT) systems for rural networks and for the Takoradi and 11 Kumasi areas
3 Electricity Access and RE (USD 102.3 million)
▪ Set up a new institutional, regulatory, and financing framework for access expansion, including the establishment of a Rural Electrification Agency (REA) which will manage the Rural Electrification Fund (REF) to finance future access expansion. ▪ Existing utility companies, cooperatives, and private sector will be the service providers ▪ Off-grid solutions: provide financing for investments, technical assistance and training for ECG and NED distribution networks (75,700 connections), extend these networks where economically viable (58,600 connections), develop new, isolated mini-grids serving towns and clusters of consumers far from existing networks (20,000 connections), and supply solar PV lanterns and systems for lighting in remote rural areas (10,000 households) ▪ Introduce new financing mechanisms: (1) to encourage the development of small, private energy businesses and (2) a financing mechanism that combines long-term consumer credits with a capital subsidy for low-income consumers following a "dealer sales/consumer credit model", which will consist of a tripartite agreement for the installation and maintenance of Solar-PV systems involving dealers, the consumers, and the ARB Apex Bank, which functions as a "mini Central Bank" for the rural and community banks, a grant from GPOBA will provide partial subsidies to the poorest consumers to make SHS more affordable
▪ Total Project Costs: USD 210.55 million financed by the Government of Ghana (USD 21.8 million), IDA (USD 90 million, 40 years maturity, 10 years period), Global Environment Facility (USD 5.50 million), Africa Catalytic Growth Fund (USD 50 million), AfDB (USD 18.25 million), Global Partnership on Output-based Aid (USD 6.25 million), Local Financial Intermediaries (USD 7.75 million), Swiss Agency for Development & Cooperation (USD 11 million). ▪ IDA disbursements: USD 1.56 million (2008), USD 6.68 million (2009), USD 16.73 million (2010), USD 32.55 million (2011), USD 22.79 million (2012), USD 9.69 million (USD)

Source: World Bank (2007), Project Appraisal Document GEDAP.

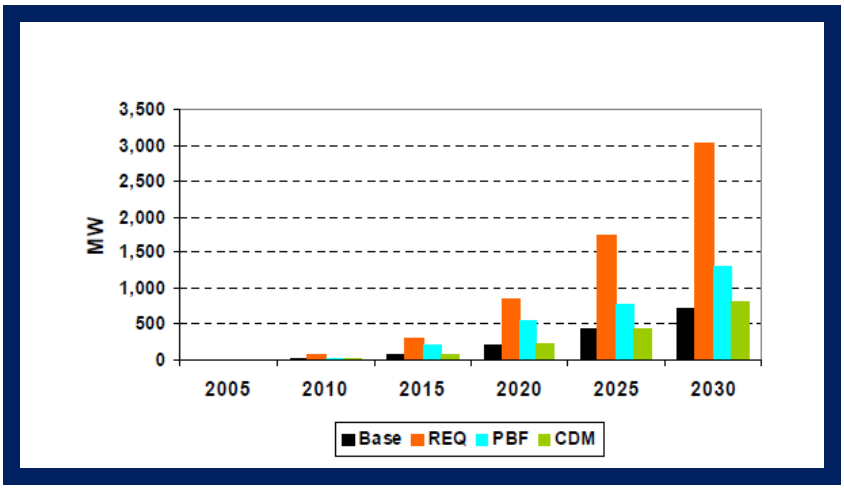


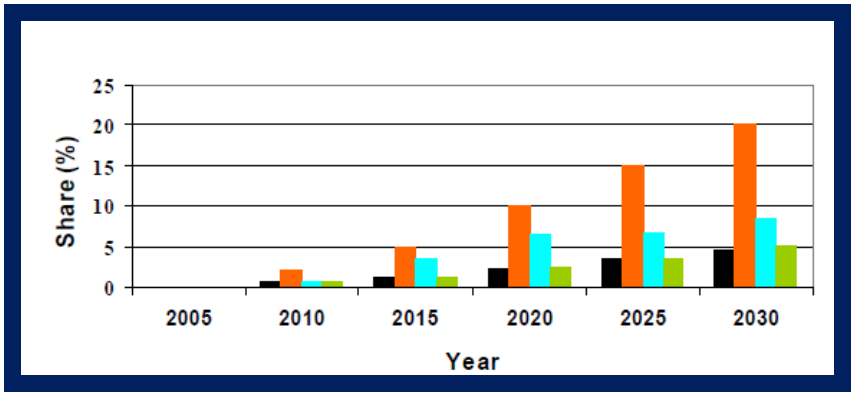
Source: World Bank (2007), Project Appraisal Document GEDAP, p. 131.

Annex 6

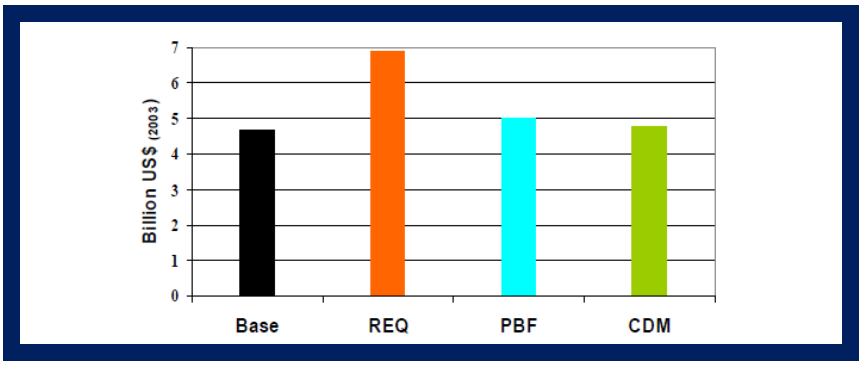
Ghana Policy Scenarios: RE Quota / Public Benefit Fund / CDM

- Electricity Generating Capacity by RE Technology under Different Scenarios: Renewable Energy Quota (REQ) / Public Benefit Fund (PBF) / CDM Scenario*



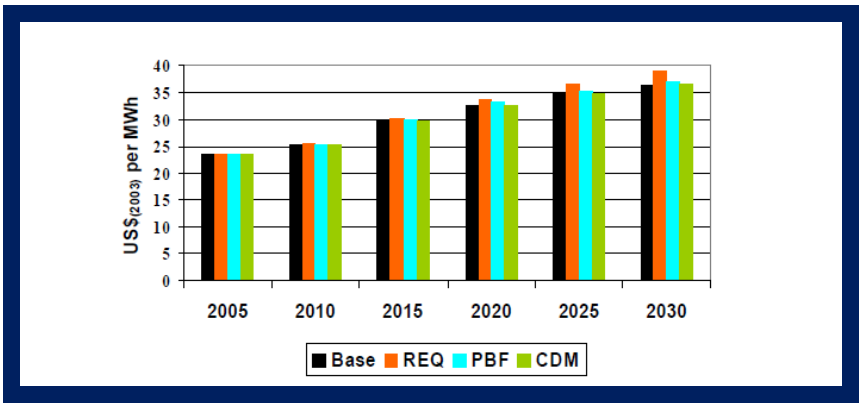


- Total Investments Required for Electricity Generating Capacity (2005 – 2030)*

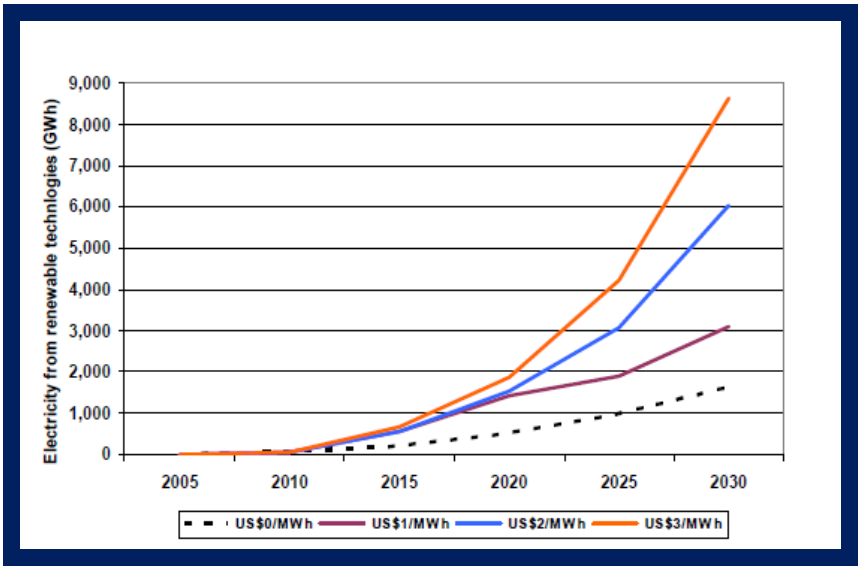


* Source: UN-ENERGY Demonstration Study (2006), Assessing Policy Options for Increasing the Use of Renewable Energy for Sustainable Development. Modelling Energy Scenarios for Ghana.

- Average Cost of Electricity Generation*



- Impact of Levy Rate on RE Electricity Generation in PBF Scenario*



* Source: UN-ENERGY Demonstration Study (2006), Assessing Policy Options for Increasing the Use of Renewable Energy for Sustainable Development. Modelling Energy Scenarios for Ghana.

- Techno-economic Data for Existing and Future Power Plants

Name	Overnight investment cost (US$/kW)	Fixed O&M cost (US$/kWyr)	Variable O&M cost (US$/MWh)	Construction time (Years)	Efficiency (%)	Levelised Generation Cost [b] US$/MWh
Tapco	[a]	17	2.3	[a]	40.4	76.8[c]
Tico	[a]	13	2.3	[a]	26.9	110.6[c]
Thema	[a]	8	1.1	[a]		125.6[c]
Barge	[a]	10	1.1	[a]		61.9[c]
CCGT[e]	550	12	2.1	3	50	42.7
CT[f]	400	10	1.1	3	30	59.6
Coal steam	1,050	25	3.1	4	36	39.7
Wind farm (Volta)	1,250	25	-	2	-	54.7[d]
Wind farm (Coast)	1,250	25	-	2	-	58.6[d]
Wind rural	1,250	25	-	2	-	65.7[d]
Solar PV	4,000	10	-	2	-	187.6
Nuclear	1,680	59	0.4	5	33	40.2
T&D[g]	1,000	9			90	10.7

[a] Existing plants.
[b] 8% discount rate.
[c] Assuming whole investment has been paid. Fuel of Tapco and Tico is light crude oil. For barge, levelised generation cost based on natural gas.
[d] The plant factors for wind farm (Volta region), wind farm (coast) and 'wind rural' are 30%, 28% and 25% depending upon respective wind regimes.
[e] Combined cycles gas turbine.
[f] Combustion turbine.
[g] Transmission and distribution.
Sources: Based on data from ECG (2005), OECD (2005) and EIA (2004).

Source: UN-ENERGY Demonstration Study (2006), Assessing Policy Options for Increasing the Use of Renewable Energy for Sustainable Development. Modelling Energy Scenarios for Ghana.