SUSTAINABLE
ENERGY FOR ALL

Rapid Assessment Gap Analysis

Ghana

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Sustainable Energy for All Acceleration Framework - Ghana

Situational Analysis Report

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1. BACKGROUND

In recognition of the critical need to improve global access to sustainable, affordable and environmentally sound energy services and resources, the United Nations General Assembly has declared 2012 the International Year of Sustainable Energy for All and urged Member States and the UN system to increase the awareness of the importance of addressing energy issues and to promote action at the local, national, regional and international levels. In response, the UN Secretary General has launched a global Initiative to achieve Sustainable Energy for All by the year 2030. The key objectives under this goal are: (1) ensuring universal access to modern energy services; (2) doubling the rate of improvements in energy efficiency; and (3) doubling the share of renewable energy in the global energy mix.

This document presents the Situational Analysis of the energy sector of Ghana, with particular reference to the three objectives of "sustainable energy for all."

In order to apply the SEAAF, Energy Commission in Ghana, in collaboration with the UNDP Country Office, issupporting key stakeholders to develop a comprehensive plan of action, comprising critical actions and commitments to address prioritized needs in the energy sector based on the application of the SEAAF. The process involves activities leading to three key outputs, namely:

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

- Prioritized commitments and a Plan of Action, broadly agreed upon with implementing partners; and

- Draft Partnership Agreements for implementation of the plan of action.

2. SUMMARY OF KEY FINDINGS AND CONCLUSIONS

2.1.1 Universal Access to Electricity

2.1.1.1 Gap Analysis

The Ministry of Energy has developed the National Energy Policy, 2010 that provides direction to all energy programmes, including those related to access to electricity. The policy is

supported by the Energy Sector Strategy and Development Plan, 2010. The Vision of Ghana's Energy Sector, as presented in the "Energy Sector Strategy & Development Plan, 2010" is "to ensure availability of and universal access to energy services and for export by 2020." The power sector is characterized by a number of strengths which provide opportunities for the realization of the goal of universal access to electricity.

The key issues and gaps to be addressed under the Ghana's SE4ALL Action Plan are identified and summarised as follows:

- Provision of major incentives for the commercial development of the sub-sector by private sector investment. Increased private sector investment in power generation infrastructure through IPPs will reverse the current situation of the very low proportion of direct investment from the private sector;

- Promotion of productive use of electricity to accelerate agricultural and industrial development to address limited productive uses of electricity; and

- Improve technical, managerial, financial and regulatory capacity of key institutions in order to address inefficiencies, e.g. existing transmission and distribution infrastructure and systems are inefficient resulting in heavy losses

In terms of ensuring access to clean fuels and devices for cooking and heating, Ghana has adopted a multi-faceted approach with three main pillars, comprising the promotion of the following:

a. Liquefied Petroleum Gas
b. Improved Cook Stoves
c. Productive Uses of Energy

2.1.2 Liquefied Petroleum Gas (LPG)

The main programmes that will be implemented to deliver SE4ALL goals can be summarized as follows:

- Speed up the establishment of a Natural Gas Processing Plant to produce LPG from the associated gas to be produced from the Jubilee Oil and Gas Field. It is estimated that 10,000 barrels (1,340 tonnes) a day of LPG could be produced from the gas from the Jubilee Field;
- Re-capitalise the Ghana Cylinder Manufacturing Company (GCMC) to expand production capacity. The production of cylinders will focus on small sized cylinders that will be affordable to households in rural communities;
- Construct LPG storage and supply infrastructure in all regional and district capitals in the Long term. In the medium term, it is intended to develop district capital LPG infrastructure;
- Increase the LPG distribution margin.

2.1.2.1 Gap Analysis

Ghana has implemented an LPG promotion programme since 1989. The experiences gained and recent developments of demand outstripping supply provide a strong basis for developing a strategy towards the realization of the dual Government policy objectives of 50% access by 2015 and ensuring supply reliability.

In summary, the main challenges to be addressed in the sector include inadequate infrastructure in the entire LGP value-chain; inadequate supply of LPG to meet the increasing demand of LPG and increased use by motorists; outmoded, inefficient and inequitable modalities for delivery of LPG to consumers; and inefficient LPG cylinder management

The LPG Retail Model which at the moment has 320 small refilling plants of 10-20 tonnes is outmoded because they are located mainly in high density population centres; 60% of district capitals have no stations; transaction cost is high; and there are serious safety concerns on quality of LPG cylinders.

In respect of LPG cylinder management, which is a key component of the LPG infrastructure, the issues to be addressed include Supply and handling of LPG cylinders; Distribution of the cylinders in remote rural communities; Responsibility for care of LPG cylinders - recertification, repairing, withdrawal; and Institutional capacity building to ensure the efficient supply and distribution of LPG.

The key issues and gaps to be addressed under the Ghana's SE4ALL Action Plan relating to access to clean energy are identified and summarised as follows:

- Uncertainty concerning the attainment of 50% access to LPG by 2015 if the fuel is to be rendered less affordable by the removal of the subsidy on LPG;
- The challenge concerning the use of LPG as automobile fuel; and
- Development of other policy measures (apart from pricing of the fuel) that can be introduced to help promote the use of LPG.
- Some stakeholders have made the following recommendations to address these issues:
- Need to introduce a more effective Business Model for managing LPG cylinder supply chain in order to make full cylinders available within 5 minutes' walk from households, especially in petrol filling stations and general goods retail shops.
- Need to develop a new business model to facilitate rapid household/commercial access to LPG as a fuel for cooking.
- Ensuring adequate investment in the cylinders, build up the distribution network and retail outlets, modern high speed quality controlled plant, hydro testing and recertification of cylinders and withdrawal, or repair cylinders.
- Need for the development of networks of gas shops/outlets, the review UPPF modalities, and the promotion of social marketing
- Reform of LPG for cooking subsidy policy to make it sustainable and equitable, and possible replacement of subsidy on the LPG fuel with subsidy on cylinders /accessories to check abuse of the subsidy policy.

2.1.3 Improved Cook Stoves

Fuel wood and charcoal meet approximately 75% of Ghana's fuel requirements. Approximately 69% of all urban households in Ghana use charcoal. The annual per capita consumption is approximately 180 kg; the total annual consumption is about 700,000 tonnes. Accra and Kumasi, the two largest cities in Ghana, account for 57% of all charcoal consumed in the country.

The focus of the biomass strategy, as indicated in the Energy Sector Strategy and Development Plan, 2010 is the (i) regeneration of forest cover through afforestation; and (ii) improvement in the production and efficient use of wood fuels. In the long term, the focus is on fuel substitution to alternative sources of energy.

2.1.3.1 Gap Analysis

Improved cookstoves are now more available commercially in Ghana, with the setting up of private sector cookstove manufacturing firms such as Toyola Energy Limited. In addition, significant experience has been accumulated in developing and implementing small-scale and disaggregated financing programs.

Furthermore, new financing instruments and sources, especially those linked to climate-change mitigation, are available. The Global Environment Facility, Carbon Funds, and Climate Investment Funds offer potential opportunities for financing.

Coalitions supporting improved cookstoves and clean cooking are also being formed, as a result of a resurgence of interest in household energy use. One of such alliance that has been recently formed is the Global Alliance for Clean Cookstoves (GACC), led by the United Nations Foundation (World Bank, 2011).

In order to scale up the adoption of improved cookstoves nationwide requires the implementation of sustainable promotional measures that:

- Promote technical research and development to adapting cookstoves and programs to country context;
- Develop performance standards and benchmarks on safety, (energy) efficiency, emissions, and durability;
- Promote awareness raising, consumer research and business development taking account of consumer preferences and behaviour;
- Develop innovative financing mechanisms that can target subsidies and grants;
- Enhance the capacity of local and national institutions to promote advanced biomass cookstoves;
- Encourage the establishment of energy funds enable financial institutions to effectively administer support to promote biomass cookstoves; and
- Develop and implement coordination, monitoring and evaluation (M&E) mechanisms;

2.1.4 Productive Uses of Energy

The National Energy Policy of 2010 specifies that productive uses of electricity (PUE) will be promoted as an integral part of the Rural Electrification Programme. The objective of policy measures to increase productive use of energy is to stimulate economic development by ensuring that energy plays a catalytic role in the economic development of the country.

The Energy Sector Strategy and Development Plan of 2010 also indicated that 5 pilot PUE projects would be completed by 2013; a comprehensive National PUE Plan would be completed by December 2014; and implementation of the PUE Plan would commence by Jan 2015.

2.1.4.1 Gap Analysis

The key issues and challenges identified in the promotion of productive uses of energy include the following:

- Development of strategic partnerships with clear roles and responsibilities for key project stakeholders including development partners, Ministries, Departments and Agencies, MMDAs, Community-based organisations, financial institutions, NGOs and private sector entrepreneurs and investors;
- Provision of sound business development training for key project implementers/managers, service providers and beneficiaries of PUE projects.
- Introduction of new business-oriented models and more robust results-based planning, monitoring and evaluation indicators and targets for PUE pilot projects, to ensure long term impact and sustainability of the projects.
- Participation of Municipal and District Assemblies in the monitoring and evaluation of PUE projects, with the assistance of Implementation Committees that will be formed in the various communities where these projects are identified and implemented.
- Improved efficiency in the operation and maintenance of machinery and equipment, and adoption of technological improvements and upgrades.
- Better use and leverage of technical and research institutions such as the GRATIS Foundation, which are widely represented across the lengths and breadth of the country.

2.1.5 Promotion of Energy Efficiency

One of the strategic goals of National Energy Policy of 2010 is to ensure end-use efficiency and conservation of energy through the following policy prescriptions:

- An appropriate pricing regime for energy services established to provide incentives to domestic and industrial consumers to voluntarily manage their energy consumption;
- Programmes and measures developed and implemented to assist consumers optimise their energy use;
- Implementation of sustained and comprehensive public education and awareness creation campaign on the methods and benefits of energy conservation supported;
- Establishment of a Centre for Energy Efficiency promoted; and

- Local production, importation and use of high energy consuming vehicles and inefficient electricity consuming equipment and appliances discontinued, through legislation.

2.1.5.1 Gap Analysis

The main strengths related to the promotion of energy efficiency are the existence of newly enacted and updated laws to regulate end-use efficiency and conservation and high level of awareness by Government and key stakeholders of the need for end-use energy efficiency and conservation following the energy crisis in 2007 and increasing cost of energy. On the other hand, the challenges related to the promotion of energy efficiency are significant. They include:

- Weak public education and awareness of significance and measures for energy efficiency and conservation;
- Lack of fiscal and financial incentives to encourage the use of energy efficient appliances and technology;
- Inadequate financing for energy efficiency and conservation programmes;
- Limited outreach of relevant institutions to extend services to districts and rural communities;
- Weak institutional capacity for monitoring and enforcement of relevant regulations; and
- Weak coordination of monitoring and enforcement of relevant regulations

In terms of the SE4ALL, the key issues to be addressed to promote of energy efficiency in Ghana include:

- Intensive and extensive public awareness and education;
- Improved institutional capacity building and effective coordination for monitoring and enforcement of relevant regulations;
- Fiscal and financial incentives to encourage the use of energy efficient appliances and technology by households, commercial and industrial sectors;
- Innovative financing schemes for energy efficiency and conservation programmes; and
- Addressing gaps in statistical data for periodically evaluating the rates of energy efficiency and conservation nationwide, covering domestic, industrial, commercial and agricultural users and public services (e.g. health and education).

2.1.6 Share of Renewable Energy in the National Energy Mix

The overall policy objective for the Renewable Energy sub-sector is to increase renewable energy supply in the total national energy mix to 10% by 2020 and ensure its efficient production and use. Ghana's Parliament has passed the Renewable Bill 2011, awaiting Presidential assent into law.

2.1.6.1 Gap Analysis

The main strengths related to the promotion of renewable energy in the national energy mix are summarized as follows:

Biomass:

- Widespread availability of biomass resources

Mini-hydro, Solar and Wind energy:

- Favourable locations for mini-hydro development identified
- Favourable wind speed in coastal areas
- Solar radiation levels generally satisfactory

Waste-to-Energy

- Widespread availability and generation of municipal, industrial and agricultural waste

Despite these strengths and opportunities, many rural communities still regard renewable energy (RE) an inferior forms of energy and therefore integration into the NES will require extensive rebranding, strategizing and planning to ensure effective integration of RE into Ghana's energy mix.

Other challenges specific to the various forms of renewable energy include:

Biomass

- Unsustainable production techniques
- Inefficient utilization
- Difficulties in obtaining secure tenure for large tracts of land for commercial development of biomass

Mini-hydro, Solar and Wind energy

- High cost of energy generation due to current state of technology
- Mini-hydro highly susceptible to climate changes

Waste-to-Energy

- Low exploitation of waste-to-energy technologies
- High cost associated with the collection and management of waste materials.

The under listed are key issues and gaps related to the promotion of renewable energy in the national energy mix:

- Availability of land with secure tenure for private sector investment in large-scale biomass development;
- Long-term sustainability of biomass production;
- High initial investment cost of energy generation from solar, wind and mini-hydro;
- High cost of waste collection and management; and
- Inadequate statistics and data disaggregation on renewable energy.

1. INTRODUCTION

1.1 BACKGROUND

Energy plays a significant role in improving people's living, thereby contributing to development. It supplies water and fuels agricultural output, health, education, job creation and environmental sustainability. Despite this, over 1.6 billion people in developing countries are deprived of access to reliable and affordable energy services (such as electricity and LPG), and over 80% of the population of sub-Saharan Africa use traditional biomass for cooking and heating. With more than one-third of a household's budget being set aside for fuel costs in many countries, the region's population pays an onerous price for fuel (mainly biomass) that is of poor quality and not very effective. In many countries in sub-Saharan Africa, there is inadequate access to adequate, affordable, effective and environmentally sustainable energy services that could support economic and human development.

The predominance of traditional fuels for cooking – over 60% dependency on biomass in Africa, and about 80% in ECOWAS countries - takes a toll on the environment (soil erosion, desertification, etc.), and the absence of modern fuels propels the poverty spiral further downward. However, increasing access to good, affordable modern energy services is likely to engender considerable benefits in terms of people's living conditions, as well as helping to achieve Millennium Development Goals.

Though energy is not explicitly taken into account in the Millennium Development Goals, the contribution of energy services to their achievement is widely acknowledged. Figure 1.1 shows the relationship between access to energy services and a selection of the eight Millennium Development Goals.

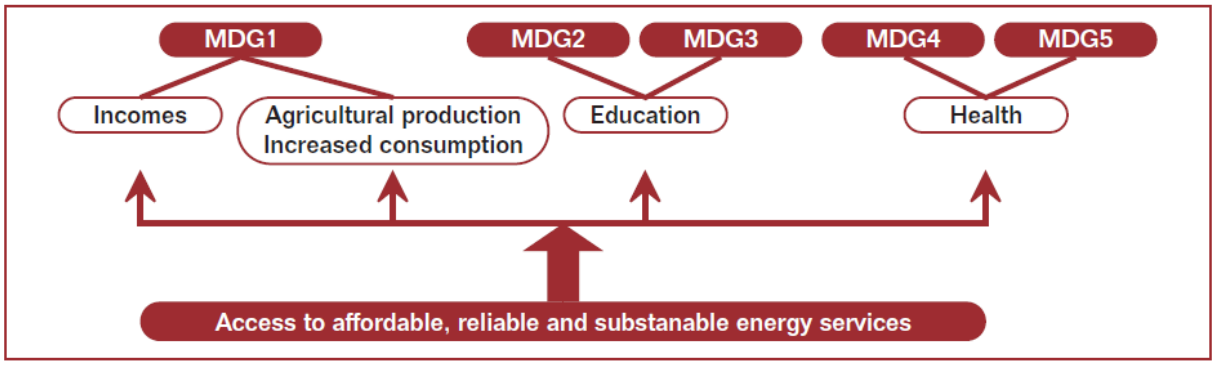

Figure 1.1: Relationship between energy and achieving MDGs

1.1.1 Sustainable Energy for All Acceleration Framework (SEAAF) in Ghana

In recognition of the critical need to improve global access to sustainable, affordable and environmentally sound energy services and resources, the United Nations General Assembly

has declared 2012 the International Year of Sustainable Energy for All and urged Member States and the UN system to increase the awareness of the importance of addressing energy issues and to promote action at the local, national, regional and international levels. In response, the UN Secretary General has launched a global Initiative to achieve Sustainable Energy for All by the year 2030. The key objectives under this goal are: (1) ensuring universal access to modern energy services; (2) doubling the rate of improvements in energy efficiency; and (3) doubling the share of renewable energy in the global energy mix.

In the context of the Secretary General's Initiative and the implementation of the International Year of Sustainable Energy for All 2012 at the national level, UNDP provides support to countries to accelerate progress on the achievement of universal access to sustainable energy by 2030. The Sustainable Energy for All Acceleration Framework (SEAAF) will assist countries to analyze constraints and identify and initiate concrete commitments and actions towards the three objectives of "sustainable energy for all."

Specifically, the aim of the SEAAF approach is to assist countries address commonly observed challenges in energy policy, planning and programming, such as advancing demand-driven prioritization of energy services based on development needs; coordinating multi-sectoral responses to scale up equitable energy access; and establishing inclusive and participatory multi-stakeholder partnerships to deliver universal access to sustainable energy. The SEAAF entails a process of undertaking a situation analysis, identifying existing interventions and gaps; prioritizing constraints on progress; and identifying measures and commitments for action and partnership agreements for their implementation.

This document presents the Situational Analysis of the energy sector of Ghana, with particular reference to the three objectives of "sustainable energy for all."

1.2 METHODOLOGY

In order to apply the SEAAF, the UNDP Country Office and the Energy Commission in Ghana, are supporting key stakeholders to develop a comprehensive plan of action, comprising critical actions and commitments to address prioritized needs in the energy sector based on the application of the SEAAF. The process involves activities leading to three key outputs, namely:

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

- Prioritized commitments and a Plan of Action, broadly agreed upon with implementing partners; and

- Draft Partnership Agreements for implementation of the plan of action.

The delivery of these outputs is being led by a Consultant and this **Situational Analysis Report** represents the consultant's first output.

Situational Analysis and Validation of Draft Report

In terms of methods, a desk review of available data (both quantitative and qualitative analysis), has been carried out and this **Draft Situational Analysis Report** prepared for presentation and validation by all key stakeholders in the public sector, private sector and civil society at a **Preparatory Workshop**.

The workshop will also afford the Consultant an opportunity to have consultations with stakeholders on the following:

- Selection of priority issues for further in-depth assessment and development of the SEAAF;
- Assessment of stakeholder interest, potential impact, power and influence; and
- Design of stakeholders' participation strategy.

Stakeholder views and contributions to the above listed discussion points will be incorporated into the **Final Situational Analysis Report,** which will be widely circulated to the relevant stakeholders.

Participatory development of Prioritized Commitments and Plan of Action

Based on the conclusions of the Situational Analysis, a **Planning and Validation Workshop** will be organized for all stakeholders (public and private sector and civil society), at which the Consultant will facilitate discussions aimed at soliciting specific prescriptions and inputs for the development of a Plan of Action, in order for the Consultant to finalize the prioritized commitments and plan of action in the SEAAF.

The Action Plan will form the basis for subsequent partnership consultations for implementation, including identifying UNDP interventions and implementation support on policy, capacity building, and institutional and service delivery measures.

The final stage of the exercise will entail the **Drafting of Partnership Agreements** for the confirmation of commitments and implementation of the plan of action.

1.2.1 Deliverables

The key deliverables of the assignment will be:

- First report of a **desk review of available data and existing initiatives**;
- Finalized report of **Situation Analysis and baseline** of sustainable energy access and sector strengths and weaknesses;

- **Draft prioritized commitments and plan of action document** that is broadly agreed upon with implementing partners; and
- **Final plan of action do**cument and **draft Partnership Agreements**.

2. COUNTRY OVERVIEW

2.1 THE ECONOMY

Ghana occupies an area of 239,000 sq km and has a population of 24,791,073 (2011 estimate). The capital city, Accra has a population of 2.3 million (2009 estimate). The country has a diverse and rich resource base with gold, timber, cocoa, diamond, bauxite, and manganese being the most important source of foreign trade. In 2007, an oilfield which may contain up to 3 billion barrels of light oil was discovered, and oil production at Ghana's offshore Jubilee field began in mid-December 2010.

In 2001, the economy grew by 14.4% and the total value of goods and services produced was US$35 billion. The services sector still remains the backbone of the economy, accounting for about 48.5% of goods and services produced in 2011, followed by industry with 25.9%, and agriculture with 25. 6%. In terms of growth, industry recorded the highest, with 41.1%, with services coming in second with 8.3%. Agriculture had the lowest growth of 0 .8%. Mining and quarrying helped push industry's growth with 206%. All the sub-sectors under services recorded some significant growth; however agriculture performed badly, with the exception of cocoa, which went up by 14%. The performance of the services, now makes the country a service led economy. The GDP per capita is US$2,500 (2010 estimate).

The labour force of Ghana is estimated to be 10.6 million people (2010 estimate) with 56% of them in the agriculture sector, 15% in the industry sector, and 29% in the services sector (2005 estimate). Ghana's main exports are gold, cocoa beans and timber products. Others include tuna, aluminium, manganese ore, diamonds and horticulture. The main exports partners are Netherlands, Burkina Faso, South Africa and United Kingdom.

Agriculture is predominantly practised on smallholder, family-operated farms using rudimentary technology to produce about 80% of Ghana's total agricultural output. It is estimated that about 2.74 million households operate a farm or keep livestock (Ministry of Food and Agriculture, 2007). According to the 2000 census, 50.6% of the labour force, or 4.2 million people, are directly engaged in agriculture. About 90% of farm holdings are less than 2 hectares in size. Larger scale farms and plantations produce mainly oil palm, rubber and coconut and to a lesser extent, maize, rice and pineapples. Agricultural production is generally dependent on rainfall, although an estimated 6,000 farm enterprises nation-wide were using some means of irrigation in 1999. In 2002, the total area under formal irrigation was around 11,000 hectares whereas the potential area – including inland valleys – that could be developed for irrigation is estimated at 500,000 ha. The Ghana Irrigation Development Authority (GIDA) in 2000 identified 32,000 hectares of under-developed inland valleys throughout the country that could benefit from moisture improvement technologies for food production.

2.2 ENERGY SITUATION

2.2.1 Energy Supply

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

2.2.1.1 Woodfuels Supply

The bulk of energy supply in Ghana is met from woodfuels, i.e. firewood and charcoal. Woodfuels account for over 70% of total primary energy supply and about 60% of the final energy demand. The supply of primary woodfuel in 2009 was estimated to be 20 million tonnes. The supply of firewood was estimated to be 9.2 miilion tonnes, whilst that of charcoal was estimated to be 2.2 million tonnes in 2009 (see Tables 2.1 and 2.2).

Table 2.1: Primary Woodfuel Supply (kilotonnes)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Woodfuel Supply	18,000	18,000	19,000	19,000	20,000	20,000	20,000	20,000	20,000	20,000

2005 onwards are projections

Source: Energy Commission, 2011

Table 2.2: Firewood and Charcoal Supply (kilotonnes)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Firewood	7,100	8,000	8,300	8,600	8,700	8,800	8,900	9,000	9,100	9,200
Charcoal	1,563	1,625	1,688	1,750	1,788	1,825	1,925	2,000	2,125	2,175

2005 onwards are projections

Source: Energy Commission, 2011

The bulk of woodfuels amounting to 90% is obtained directly from the natural forest. The remaining 10% is from wood waste i.e. logging and sawmill residue, and planted forests. The transition and savannah zones of Ghana, mainly the Kintampo, Nkoranza, Wenchi, Afram Plains, Damongo districts provide the bulk of dense wood resources for woodfuels. However, woodfuel resources are depleting at a faster rate as a result of unsustainable practices in the production and marketing of the product that incurs high levels of waste. According to the UN Food and Agriculture Organisation (FAO), the rate of deforestation in Ghana is 3% per year (Trossero, FAO, 2002).

In 2000, the annual production or yield of wood was about 30 million tonnes of which about 18 million tonnes was available and accessible for woodfuels. Although the exploitation of wood resources for woodfuels is not the main cause of deforestation, there are indications that the preferred woodfuel species are gradually disappearing. The major charcoal production areas of

Donkorkrom, Kintampo, Nkoranza, Wenchi, Damongo show physical signs of depleted woodfuel resources. As a result, producers have to travel longer distances in search of wood for charcoal production.

Charcoal and fuelwood are normally transported from the production centers (mainly in the rural areas) to the major cities and other urban centers where they are sold by wayside retailers to final consumers. A fraction of the charcoal produced is, however, exported to West African and European markets. The woodfuel industry is handled almost exclusively by private individuals with little regulation by the Government. The most recent regulatory measure introduced by the Energy Commission is the ban on the export of charcoal produced from unapproved sources, that is, sources other than sawmills residue or forest planted for that purpose. Thus, exporting charcoal produced from the direct wood sources, that is, wood harvested from the natural forest, is not allowed. Since July 2003, all exporters of charcoal are required to obtain a permit or license from the Energy Commission.

2.2.1.2 Power Generation

Power generation in Ghana is from two hydro power plants at Akosombo and Kpong and some thermal plants. As at the end of 2010, the installed capacity of hydro generation was 1,180 MW whilst the installed capacity thermal generation was 989.5 MW (see Table 2.3). The electricity generation from the hydro source was 6,995 GWh, and the generation from thermal sources was 3,171 MW (see Table 2.4). The Volta River Authority (VRA), a publicly owned power utility is the owner and operator of the two hydro plants at Akosombo and Kpong. The transmission network is owned and operated by the Ghana Grid Company.

Distribution of electricity is undertaken by two distribution utilities – Electricity Company of Ghana (ECG) and Northern Electricity Department (NED), which is a subsidiary of VRA. The ECG is charged with the bulk purchase of electricity from VRA for distribution throughout the country to all categories of consumers, with the exception of Volta Aluminum Company (VALCO), the Akosombo township, and the mines. In 1987, following the establishment of NED, ECG's distribution activities were restricted to the six southern regions, i.e., Ashanti, Greater Accra, Eastern, Western and Volta regions.

NED was established in 1987 as a subsidiary of VRA to take over from ECG the responsibility of procurement, distribution and sale of electricity in the northern sector of the country comprising Brong Ahafo, Northern, Upper East and Upper West Regions.

Table 2.3: Generation Capacity (End of December 2010)

Plant	Fuel Type	Capacity (MW)	
		Installed	Dependable
Hydro Generation			
Akosombo	Water	1,020	900
Kpong	Water	160	140
Sub-Total		1,180	1,040
Thermal Generation			
Takoradi Power Company (TAPCO)	LCO/Diesel/Natural Gas	330	300
Takoradi International Company (TICO)	LCO/Diesel/Natural Gas	220	200
SunonAsogli Power (Ghana) Limited	Natural Gas	200	180
Tema Thermal 1 Power Plant (TT1PP)	LCO/Diesel/Natural Gas	110	100
Mines Reserve Plant (MRP)	Diesel/Natural Gas	80	40
Tema Thermal 2 Power Plant (TT2PP)	Diesel/Natural Gas	49.5	45
Sub - Total		989.5	865
Total		**2,170**	**1,905**

Source: Energy Commission, 2011

Table 2.4: Electricity Generation by Plant (GWh)

SOURCE	PLANT	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hydro	Akosombo	5,557	5,524	4,178	3,210	4,404	4,718	4,690	3,104	5,254	5,842	5,961
	Kpong	1,052	1,085	858	675	876	911	929	623	941	1,035	1,035
	Total	***6,610***	***6,609***	***5,036***	***3,885***	***5,281***	***5,629***	***5,619***	***3,727***	***6,196***	***6,877***	**6,995**
Thermal	TAPCO	345	740	874	1,328	536	831	1,416	1,521	874	453	1,234
	TICO	268	510	1,363	668	222	328	1,395	1,417	1,063	1,040	1,160
	TT1PP	NA	NA	NA	NA	NA	NA	NA	0	0	570	591
	TRPP	NA	NA	NA	NA	NA	NA	NA	162	85	0	0
	ERPP	NA	NA	NA	NA	NA	NA	NA	80	45	0	0
	KRPP	NA	NA	NA	NA	NA	NA	NA	33	16	0	0
	Mines Reserve Plant	NA	NA	NA	NA	NA	NA	NA	38	46	18	20
	TT2PP	NA	NA	NA	NA	NA	NA	NA	0	0	0	28
	SunonAsogli Power Plant	NA	NA	NA	NA	NA	NA	NA	0	0	0	138
	Total	***613***	***1,251***	***2,237***	***1,997***	***758***	***1,159***	***2,810***	***3,251***	***2,128***	***2,081***	**3,171**
Grand Total		**7,223**	**7,859**	**7,273**	**5,882**	**6,039**	**6,788**	**8,429**	**6,978**	**8,323**	**8,958**	**10,166**

Source: Energy Commission, 2011

The share of hydro generation in the total power generation has reduced over the years from 92% in 2000 to 69% in 2010. During the energy crisis in 2007 when the water level in the hydro dam fell below acceptable figures, the share of hydro generation dropped to 53% (see Table 2.5). The import and export of electricity in Ghana are presented in Table 2.6. Though the country has been importing some electricity over the years mainly from La Cote d'Ivoire, it has remained a net exporter (mainly to Togo and Benin) since 2008. Figure 2.1 shows the transmission network in Ghana.

Table 2.5: Share of Electricity Generation by Plant (%)

SOURCE	PLANT	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hydro	Akosombo	77	70	57	55	73	70	56	44	63	65	59
	Kpong	15	14	12	11	15	13	11	9	11	12	10
	Total	***92***	***84***	***69***	***66***	***87***	***83***	***67***	***53***	***74***	***77***	***69***
Thermal	TAPCO	5	9	12	23	9	12	17	22	11	5	12
	TICO	4	6	19	11	4	5	17	20	13	12	11
	TT1PP	NA	NA	NA	NA	NA	NA	NA	0	0	6	6
	TRPP	NA	NA	NA	NA	NA	NA	NA	2	1	0	0
	ERPP	NA	NA	NA	NA	NA	NA	NA	1	1	0	0
	KRPP	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
	Mines Reserve Plant	NA	NA	NA	NA	NA	NA	NA	1	1	0	0
	TT2PP	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
	SunonAsogli Power Plant	NA	NA	NA	NA	NA	NA	NA	0	0	0	1
	Total	***8***	***16***	***31***	***34***	***13***	***17***	***33***	***47***	***26***	***23***	***31***
Grand Total		**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Energy Commission, 2011

Table 2.6: Electricity Import & Export (GWh)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Import	864	462	1146	940	878	815	629	435	275	198	106
Export	392	302	612	604	665	639	754	246	538	752	1036
Net Import	*472*	*160*	*534*	*336*	*213*	*176*	*-125*	*189*	*-263*	*-555*	*-930*

Source: Energy Commission, 2011

Figure 2.1: The 161 KVA Transmission Network in Ghana

Source: Ministry of Energy, 2011

2.2.1.3 Supply of Petroleum Products

LPG is produced by the nation's single oil refinery, the Tema Oil Refinery, together with other petroleum products such as gasoline and kerosene. LPG production levels have fluctuated over the years, ranging from 75,300 tonnes in 2005 to 31,600 tonnes in 2010 (see Table 2.4). The shortfall in supply is compensated for through imports (see Table 2.5).

Table 2.4: Petroleum Products Production (kilotonnes)

PRODUCT	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LPG	9.7	7.0	24.4	52.6	65.5	75.3	35.8	67.3	54.6	14.0	31.6
Gasoline	238.6	286.3	346.2	433.8	553.1	567.1	294.4	493.0	391.2	135.0	337.7
Kerosene	51.8	98.1	61.1	109.6	111.1	87.7	65.1	122.0	168.6	48.7	71.0
ATK	108.3	64.0	81.6	85.6	106.9	119.0	46.2	65.8	21.3	1.3	116.1
Gas Oil	358.1	353.5	446.5	506.6	568.4	486.3	294.2	398.2	360.5	102.8	292.6
RFO	261.9	261.1	195.7	163.5	199.1	205.4	155.5	48.7	225.4	25.3	96.8
Total	**1,028.4**	**1,069.9**	**1,155.4**	**1,351.8**	**1,604.0**	**1,540.8**	**891.3**	**1,194.9**	**1,221.5**	**327.1**	**945.8**

Source: Energy Commission, 2011

Table 2. 6: Petroleum Products Import (kilotonnes)

PRODUCT	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LPG	35.4	35.6	32.0	16.7	11.0	7.1	67.8	47.2	67.8	150.6	148.0
Gasoline	387.0	389.4	370.8	232.1	255.4	167.5	360.5	274.9	254.5	563.4	570.1
Kerosene	30.4	21.5	48.8	34.6	0.0	0.0	99.9	66.7	136.4	77.7	0
Gas Oil	363.2	354.3	298.0	285.7	313.1	403.7	780.0	806.9	579.0	969.5	871.7*
RFO	0.3	0.1	0.1	NA	NA	NA	NA	NA	NA	NA	NA
Total	**816.3**	**800.9**	**749.7**	**569.0**	**579.5**	**578.3**	**1,308.1**	**1,195.7**	**1,037.7**	**1,761.3**	**1,589.8**

Source: Energy Commission, 2011

2.2.2 Energy Demand

A study on energy intensity in some sectors of Ghana's economy observed that the Industrial sector was the largest consumer of diesel fuel, followed by the services sector; the agricultural sector's share was negligible. The most common use of diesel fuel in industry varied from sub-sector to sub-sector. In general, the diesel fuel was used in operating excavators, fork lifts and dump trucks and equipment of machinery for drilling, crushing, hoisting, loading and transfer to haulage trucks, as in the mining and construction sub-sectors. Gasoline was also predominantly used in the services sector, particularly in the transport and haulage sub-sector (CEPA, 2002).

Residual fuel oil (RFO) was widely used in production processes of the manufacturing sub-sector of Industry. It was principally used for generating heat in equipment of machinery such as boilers and compressors mostly in the food processing, alcoholic beverages, textiles, iron and steel, and the non-ferrous metal industries. The bulk of woodfuels (charcoal and firewood) used in the non-household sectors was fuel for boilers of sawmills and in ovens in brick and tile and ceramic factories. Educational institutions and hospitals accounted for a smaller proportion of firewood consumption for cooking and food preparation purposes. Charcoal consumption, on the other hand, was mostly common in small-scale restaurants and eating places, but educational institutions also accounted for a relatively smaller proportion.

Kerosene was also limited in use across economic sectors other than in health and educational institutions. A fair amount of this fuel type was used in the non-ferrous metal industries and the

manufacture of professional and scientific products – basically used in boilers, ovens, and furnaces, and also as a polishing detergent. In the manufacturing sub-sector of industry, the food processing and the printing and publishing sub-divisions were key LPG-consuming activities. The Volta Aluminium Company (VALCO) and the services sector closely trailed the manufacturing sub-sector, while the contribution of the agricultural sector was negligible. The health and educational institutions were among the key consumers of LPG within the services sector — the principal uses of gas were in ovens and stoves for cooking and food preparations. Within the mining and quarrying sub-sector of industry, considerable amounts of LPG was used in furnace treatment plants, particularly in gold and diamond production, for moulding and cutting processes. Larger quantities still were used in furnaces and dryers as part of the production processes involving the smelting of aluminium and in metallurgical industries.

The foregoing trend of energy intensity in the industry, services and agriculture sectors has not changed much over the years. In 2010, in spite of an increase in electricity supply to industries, the share to the industrial sector dropped by 0.6 percentage points whilst supply to the residential sector increased by 2 percentage points in 2010 compared to the previous year. In quantitative terms, the households (residential sector) received a net more electricity of 117 GWh than the industrial sector in 2010 (see Table 2.7).

2.2.2.1 Woodfuel Consumption

It is estimated that 20 million tonnes of woodfuel are consumed annually in the form of firewood or converted for use as charcoal. A majority of households (about 80%) in Ghana depend on woodfuels for cooking and water heating in addition to commercial, industrial and institutional use, the demand for woodfuel has for the past years been on the increase. If this trend of consumption continues, Ghana is likely to consume more than 25 million tonnes of woodfuel by the year 2020 (see Figure 2.2).

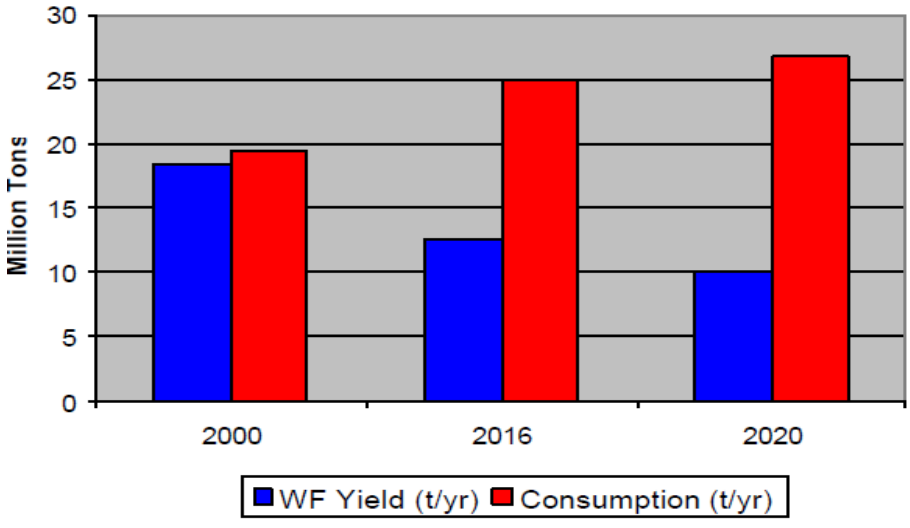

Figure 2.2: Woodfuel Balance of Ghana (2000-2020)
Source, Energy Commission (undated)

As illustrated in Figure 2.2, by 2020 the woodfuel consumption will reach 25 million tonnes and above. Most of the woodfuel supply will come from standing stocks i.e. 15 million tonnes from standing stock and the rest 10 million tonnes from regeneration or yield. This means that woodfuel supply will no longer come from regeneration but from standing stock. The implication is a direct depletion of standing stocks hence an increase in the rate of deforestation.

Proportion of Households using Firewood

According to a survey of the Energy Commission on Energy Use conducted in 2011, it was estimated that about 40.3 % of households in the country use firewood, whilst the proportion of households using firewood is high in rural areas (62.1%) than in urban areas (25.8%). About 18.2% of households in the Greater Accra Region use firewood compared to 68.9% in Northern Region. Only 4.9% of households in Accra/Tema metropolis use firewood for cooking whilst in the other Regional Capitals it is 11.5% (see Table 2.7).

Table 2.7: Use of Firewood by Region and Locality

Region/Locality	Households using Firewood for cooking (%)	Households not using Firewood for cooking (%)
Greater Accra	18.2	81.8
Eastern Region	26.8	73.2
Volta Region	37.0	63.0
Central Region	40.5	59.5
Western Region	37.9	62.1
Ashanti Region	47.2	52.8
BrongAhafo	38.5	61.5
Northern Region	68.9	31.1
Upper East	48.8	51.2
Upper West	55.3	44.7
Urban/Rural Households		
Urban	25.8	74.2
Accra/Tema	4.9	95.1
Other Regional Capital	11.5	88.5
Other District Capital	31.6	68.4
Other Urban	23.0	77.0
Rural	62.1	37.9
Coastal	52.5	47.5
Forest	57.2	42.8
Savannah	71.5	28.5
Total	40.3	59.7

Source: Energy Commission, 2011b

Firewood Consumption in Households

It is estimated that on average a household in Ghana uses 1,064.7kg of firewood annually (Table 2.8) but there are regional and rural/urban disparities. On the average, a household in the Northern Region consumes 1,173.5kg of firewood per annum whilst a household in Greater Accra consumes 903.1kg. Households in urban areas consume an average of 986.2kg of firewood per year compared to a rural household of 1,113.4kg. In terms of rural areas households in rural forest consume an average of 1,085.2kg per year whilst a household in the savannah area is 1,165.5kg of firewood per year.

Table 2.8: Average Firewood Consumed per Household per Annum by Region/Locality

Region	Annual Consumption of Firewood by a Household, kg
Greater Accra	903.1
Eastern Region	1,005.2
Volta Region	829.7
Central Region	993.7
Western Region	789.4
Ashanti Region	1,152.6
Brong-Ahafo	1,361.0
Northern Region	1,173.5
Upper East	1,037.4
Upper West	1,233.8
Urban/Rural Households	
Urban	986.2
Accra/Tema	520.8
Other Regional Capital	1,299.0
Other District Capital	981.0
Other Urban	816.6
Rural	1,113.4
Coastal	1,011.8
Forest	1,085.2
Savannah	1,165.5
National	1,064.7

Source: Energy Commission, 2011b

Proportion of Households Using Charcoal

According to the survey of the Energy Commission, about 78.8% of households in the country use charcoal (Table 2.9). The Northern Region has the highest proportion of households (90.5%) using charcoal whilst Ashanti Region has the lowest (72.4%) of households using

charcoal. In the Greater Accra Region, 75.3% of households surveyed use charcoal. About 80.1% of urban households surveyed use charcoal whilst in rural areas, 76.1% of households use charcoal. The result of the survey also reveals that, 85.3% of households in regional capitals use charcoal.

Table 2.9: Use of Charcoal by Households by Region/Location

Region	Households using Charcoal for Cooking %	Households not using Charcoal for Cooking %
Greater Accra	75.3	24.7
Eastern Region	86.2	13.8
Volta Region	80.6	19.4
Central Region	74.4	25.6
Western Region	75.9	24.1
Ashanti Region	72.4	27.6
Brong Ahafo	81.7	18.3
Northern Region	90.5	9.5
Upper East	78.6	21.4
Upper West	76.2	23.8
Urban/Rural Households		
Urban	80.1	19.9
Accra/Tema	61.0	39.0
Other Regional Capital	85.3	14.7
Other District Capital	81.6	18.4
Other Urban	79.6	20.4
Rural	76.1	23.9
Coastal	84.2	15.8
Forest	72.5	27.5
Savannah	78.7	21.3
Total	78.8	21.2

Source: Energy Commission, 2011b

The Energy Commission's Energy Use Survey estimates that averagely, a household in Ghana consumes 434.4kg of charcoal every year. However, households in the Northern Region consume an average of 510.1kg of charcoal per annum whilst their counterparts in the Upper-

East Region consume an average of 363.9kg of charcoal per year. In the case of rural and urban households, it was estimated that an average of 440.2 kg of charcoal is consumed per year in a rural household whilst a household in urban area consumes an average of 430.7kg of charcoal per annum (see Table 2.10)

Table 2.10: Average Charcoal Consumed per Household per Annum by Region/Locality

Region	Annual Charcoal Consumption by Household, kg
Greater Accra	448.8
Eastern Region	367.7
Volta Region	373.6
Central Region	418.2
Western Region	384.4
Ashanti Region	487.8
BrongAhafo	474.1
Northern Region	510.1
Upper East	363.9
Upper West	531.1
Urban/Rural Households	
Urban	430.7
Accra/Tema	444.7
Other Regional Capital	463.0
Other District Capital	422.3
Other Urban	425.1
Rural	440.2
Coastal	406.1
Forest	444.5
Savannah	445.2
National	434.4

Source: Energy Commission, 2011b

2.2.2.2 Electricity Consumption

The share of electricity supplied to the industrial sector has been decreasing since 2000 and indeed it was the sector most severely affected during the load shedding in 2003-4 and 2007 (see Table 2.11). The country underwent a nationwide load shedding from 2002-2004 due to low inflows into the Volta reservoir which culminated into reduced generation (about one-third to half capacity less) from the nation's hydropower.

Table 2.11: Grid Electricity supply, Share and Growth to the Demand Sectors

YEAR	DEMAND SECTORS										
	Industry			Non Residential			Residential			Total	
	1000 GWh	% Share	% Gr	1000 GWh	% share	% Gr	1000 GWh	% share	% Gr	1000 GWh	% Gr
2000	4.31	68.0	0	0.55	8.5	0	1.49	24	0	6.34	0
2001	4.33	66.4	0.7	0.58	8.9	8.0	1.61	25	7.9	6.53	3
2002	3.90	63.2	-10.0	0.60	9.8	4.0	1.67	27	3.7	6.17	-5.4
2003	2.21	48.4	-43.5	0.62	13.6	3.0	1,73	38	3.4	4.55	-26.3
2004	2.03	46.0	-8.0	0.66	14.6	6.6	1.78	39	3.2	4.53	-0.5
2005	2.54	49.3	25.3	0.70	13.5	5.6	1.92	37	7.5	5.16	13.9
2006	3.59	55.2	41.4	0.79	12.1	13.3	2.13	33	11.2	6.51	26.3
2007	2.70	48.2	-25.2	0. 80	14.4	1.5	2.10	37	-1.6	5.59	-14.1
2008	2.97	48.1	10.3	0.93	15.1	15.6	2.27	37	8.3	6.16	10.2
2009	2.94	47.2	-1.5	0.88	14.1	-5.4	2.41	39	6.1	6,23	1.1
2010	3.16	46.6	8.1	0.97	14.3	10.0	2.74	40	13.7	6.77	8.7
Average Growth			**-0.3**			**6.2**			**6.3**		**1.7**

Gr – growth

Source: Energy Commission, 2010

With the drastic reduction of power consumption share of the Volta Aluminium Company (VALCO) which was facing operational difficulties, the mining subsector of Industry which is dominated by the gold mining subsector and other industries have taken over the shares with the latter having the largest (see Table 2.12).

Table 2.12: Industrial Sector Grid Electricity supply and shares since 2000

YEAR	INDUSTRY SECTOR								
	VALCO			MINES			INDUSTRY less VALCO less MINES		
	1000 GWh	% Share of Industry	% Share of Total Energy	1000 GWh	% Share of Industry	% Share of Total Energy	1000 GWh	% Share of Industry	% Share of Total Energy
2000	2.50	58.2	39.5	0.63	35.0	10.0	1.17	6.8	50.5
2001	2.56	59.1	39.3	0.57	32.1	8.7	1.20	8.8	52.0
2002	2.06	52.8	33.4	0.56	30.5	9.1	1.28	16.7	57.5
2003	0.25	11.3	5.5	0.57	29.3	12.6	1.38	59.4	81.9
2004	0.01	0.5	0.2	0.60	29.7	13.2	1.42	69.8	86.6
2005	0.26	10.2	5.0	0.75	33.0	14.6	1.53	56.8	80.4
2006	1.20	33.4	18.4	0.87	36.5	13.4	1.52	30.1	68.2
2007	0.21	7.6	3.7	1.00	40.4	17.9	1.48	52.0	78.4
2008	0.17	5.8	2.8	1.14	40.9	18.6	1.65	53.3	78.6
2009	0.01	0.4	0.2	1.25	43.0	20.1	1.66	56.6	79.7
2010	0.01	0.2	0.1	1.24	39.5	18.1	1.91	60.3	81.8

Source: Energy Commission, 2010

Even though the Mining subsector had lagged behind other Industries in terms of shares, it has higher average annual consumption growth due to the increasing growth of the gold industry which accounts for about 95% of energy use in the Mining subsector (see Table 2.13). Even though, other Industry particularly manufacturing accounts for the largest share of the Industrial GDP compared to Mining, it has been dwindling, from 49% in 2006 to about 38% in 2010. The Mining subsector which is largely the gold industry, accounts for only about 13% of the Industrial GDP share, but the average annual growth from 2006 to 2010 was 6.8% compared to manufacturing of just 0.8%.

Table 2.13: Annual Electricity Consumption Growth Rates of Industry and Residential Sectors

YEAR	INDUSTRY less VALCO	MINES	*Other INDUSTRY	INDUSTRY TOTAL	RESIDENTIAL
	Percentage Growth Rate				
2000	0	0	0	0	0
2001	-1.6	-9.8	2.8	0.7	7.9
2002	3.9	-1.2	6.3	-10.0	3.7
2003	6.2	1.9	8.1	-43.5	3.4
2004	3.2	4.6	2.7	-8.0	3.2
2005	13.1	25.7	7.8	25.3	7.5
2006	4.9	16.0	-0.6	41.4	11.2
2007	3.7	14.6	-2.6	-25.2	-1.6
2008	12.5	14.1	11.4	10.3	8.3
2009	4.2	9.51	0.5	-1.5	6.1
2010	8.2	0.7	14.9	8.1	13.7
Av.Gr	**5.8**	7.5	5.1	**-0.3**	**6.3**

Other Industry implies Industry less VALCO less Mines; Av.Gr – average growth

Source: Energy Commission, 2010

After its establishment in 1997, the Public Utility Regulatory Commission (PURC) became responsible for setting electricity tariffs, in consultation with key stakeholders comprising the generators, distributors and representatives of major consumers. The PURC developed a transition plan to trigger a gradual adjustment to economic cost recovery by 2003. The automatic price adjustment formula of the Transition Plan was affected once in 2003 and twice in 2004, with the latest adjustment in 2004 affecting only the bulk supply tariff (BST) and the distribution service charge (DSC). The sum of the BST and the DSC is the end user tariff (EUT) charged by the distribution companies.

There are different tariffs for industrial, commercial (non-residential) and residential customers. The tariff for residential customers has a lifeline tariff for low consumption, which was set at 100 kWh per month maximum in 1989/90 but was downgraded to 50 kWh per month maximum by 2000. The lifeline tariff is about 6 US cents per kWh, and the Government of Ghana subsidises the lifeline consumers. The average tariff for final electricity was below 5 US cents per kWh until 1998 when it shot up to between 5.2 to 8.2 US cents per kWh. The average tariff for final electricity is currently about 20 US cents per kWh (see Table 2.14).

Table 2.14: Electricity Tariffs for various Categories of Consumers

Tariff Category	Effective Date							
	October 2003	February 2004	November 2004	February 2005	September 2006	November 2007	June 2010	March 2011
Residential								
0-50 (Ghc/kWh)	1.908*	1.908*	1.908*	1.908*	0.070	0.095	0.095	0.095
51-150 (Ghc/kWh)	0.058	0.058	0.058	0.058	0.070	0.120	0.161	0.160
151-300 (Ghc/kWh)	0.058	0.058	0.058	0.058	0.070	0.120	0.161	0.160
301-600 (Ghc/kWh)	0.102	0.102	0.102	0.102	0.120	0.160	0.210	0.208
601+ (Ghc/kWh)	0.102	0.102	0.102	0.102	0.140	0.195	0.230	0.230
Service Charge (Ghc/month)					0.500	0.500	1.500	1.500
Non-Residential								
0-300 (Ghc/kWh)	0.085	0.085	0.085	0.085	0.102	0.140	0.237	0.229
301-600 (Ghc/kWh)	0.104	0.104	0.104	0.085	0.125	0.170	0.270	0.244
600+ (Ghc/kWh)	0.104	0.104	0.104	0.104	0.145	0.195	0.413	0.385
Service Charge (Ghc/month)	2.120	2.120	2.120	2.120	2.500	2.500	2.500	2.500
SLT-LV								
Maximum Demand(Ghc/kVA/month	14.310	14.310	14.310	14.310		1.000	14.000	14.000
Energy Charge (Ghc/kWh)	0.040	0.040	0.040	0.040	0.120	0.160	0.260	0.239
Service Charge (Ghc/month)	6.360	6.360	6.360	6.360	7.500	7.500	10.000	10.000
SLT-MV								
Maximum Demand(Ghc/kVA/month	9.752	9.752	9.752	9.752	9.000	9.000	12.000	12.000
Energy Charge (Ghc/kWh)	0.038	0.038	0.038	0.038	0.050	0.091	0.198	0.185
Service Charge (Ghc/month)	6.360	6.360	6.360	6.360	12.500	12.500	14.000	14.000
SLT-HV								
Maximum Demand(Ghc/kVA/month	8.904	8.904	8.904	8.904	9.000	9.000	12.000	12.000
Energy Charge (Ghc/kWh)	0.037	0.037	0.037	0.037	0.045	0.081	0.173	0.170
Service Charge (Ghc/month)	6.360	6.360	6.360	6.360	12.500	12.500	14.000	14.000
SLT-MINES								
Maximum Demand(Ghc/kVA/month	-	-	-	-	-	9.000	14.000	14.000
Energy Charge (Ghc/kWh)	-	-	-	-	-	0.081	0.270	0.270
Service Charge (Ghc/month)	-	-	-	-	-	12.500	15.000	14.000

* Exclusive Block Charge

Source: Energy Commission, 2010

2.2.2.3 Consumption of Petroleum Products

Table 2.15 presents the consumption of petroleum products in 2000-2011. The consumption of LPG has been rising steadily from 45,000 tonnes in 2000 to 178,400 tonnes in 2010. Gasoline, gas oil and other petroleum products also rose over the period. The consumption of kerosene however showed some fluctuations over the years. The retail prices of the products in 2007-2011 are also shown in Table 2.16.

Table 2.15: Consumption of Petroleum Products

PRODUCT	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LPG	45.0	42.5	50.0	56.7	65.7	70.5	88.0	93.3	117.6	220.6	178.4
Gasoline	524.4	535.1	570.2	479.8	575.6	537.8	511.9	544.2	545.0	701.4	737.8
Premix	30.6	27.0	26.8	28.9	27.5	31.4	33.7	41.0	50.7	55.1	32.4
Kerosene	67.6	70.5	74.8	68.8	73.2	74.3	76.5	63.3	34.6	89.3	49.3
ATK	96.9	76.4	90.5	89.8	107.4	119.3	114.7	122.8	119.2	124.7	108.4
Gas Oil	665.8	685.4	717.8	755.3	848.9	880.4	934.0	1,147.0	1,092.1	1,280.0	1,271.9
RFO	57.1	52.0	51.9	45.7	45.2	47.8	56.8	51.3	47.9	40.3	30.9
Total	**1,487.3**	**1,488.8**	**1,581.9**	**1,524.9**	**1,743.5**	**1,761.5**	**1,815.6**	**2,062.9**	**2,007.0**	**2,511.3**	**2,409.1**

Source: Energy Commission, 2010

Table 2.16: Retail Prices of Major Petroleum Products (2007 - 2011)

Effective Date	Exchange Rate (Gh¢/US$)	Premium Gasoline (Gh¢/Lt)	Gas Oil (Gh¢/Lt)	Kerosene (Gh¢/Lt)	LPG (¢/kg)	RFO (¢/Lt)
01-Dec-07	0.95	1.04	1.03	0.94	1.01	0.58
16-Dec-07	0.96	1.02	1.03	0.94	1.06	0.56
02-Jan-08	0.96	1.03	1.02	0.93	1.05	0.57
16-Jan-08	0.97	1.07	1.04	0.94	1.02	0.60
01-Feb-08	0.97	1.03	1.02	0.93	1.02	0.57
16-Feb-08	0.98	1.04	1.04	0.94	1.02	0.57
01-Mar-08	0.98	1.09	1.11	1.01	1.04	0.59
16-Mar-08	0.98	1.11	1.16	1.09	1.05	0.60
01-Apr-08	0.98	1.11	1.18	1.20	1.05	0.61
16-Apr-08	0.98	1.14	1.21	1.17	1.01	0.65
03-May-08	0.98	1.19	1.25	1.19	1.00	0.67
26-May-08	0.98	1.19	1.20	1.14	1.00	0.67
16-Oct-08	1.14	1.19	1.20	1.14	1.00	0.67
01-Nov-08	1.15	1.07	1.10	1.02	0.92	0.58
16-Nov-08	1.16	1.03	1.08	1.00	0.88	0.55
01-Dec-08	1.17	0.99	1.04	0.97	0.84	0.53
12-Dec-08	1.20	0.82	0.89	0.70	0.65	0.40
09-Mar-09	1.33	0.78	0.85	0.67	0.59	0.38
16-Mar-09	1.36	0.78	0.85	0.67	0.59	0.38
01-Apr-09	1.38	0.86	0.86	0.67	0.61	0.21
16-Apr-09	1.40	0.86	0.86	0.67	0.61	0.43
06-Jun-09	1.44	1.11	1.12	0.86	0.80	0.56
16-Jul-09	1.49	1.11	1.12	0.86	0.80	0.64
31-Oct-09	1.45	1.17	1.18	0.91	0.84	0.67
04-Jan-11	1.46	1.52	1.53	0.91	1.05	0.84

Source: Energy Commission, 2010

Use of LPG by Households

In 2011, the Energy Commission organized a survey on the Energy use in the Residential, Industrial, Commercial and Services Sectors of the Economy. The results of the survey revealed that about 39.6% of the total number of households surveyed in the country use LPG for cooking. Households in Greater Accra have the highest penetration of 63.8% whilst households in Upper West Region have the least penetration of 13.9% (see Table 2.17).

In terms of urban and rural households, 50.6% of total number of urban households surveyed use LPG for cooking whilst only 23.1 % of the total number of rural households depends on LPG. In the urban areas, 85.7% of the households surveyed in the Accra/Tema metropolis use LPG for cooking compared to 46.3% of households in other regional capitals. In the case of rural areas, 29.7% of households in rural forest use LPG compared to only 13.0% of households surveyed in rural Savannah. 64.2% of the households surveyed use 14.5 kg size cylinder, thus making it the most preferred cylinder used for storing LPG in households. In addition, 15.9% of households surveyed use 13kg size cylinder for storing LPG.

Table 2.17: Proportion of Household who use LPG (%)

Region	% of Households using LPG for Cooking	% of Households not using LPG for Cooking
Greater Accra	63.8	36.2
Eastern	59.3	40.7
Volta	44.3	55.7
Central	36.8	63.2
Western	40.8	59.2
Ashanti	34.4	65.6
Brong-Ahafo	37.3	62.7
Northern	10.1	89.9
Upper East	34.0	66.0
Upper West	13.9	86.1
Total	**39.6**	**60.4**
Urban/Rural Households		
Urban	50.6	49.4
Accra/Tema	85.7	14.3
Other Regional Capital	46.3	53.7
Other District Capital	46.9	53.1
Rural	23.1	76.9
Coastal	27.3	72.7
Forest	29.7	70.3
Savannah	13.0	87.0
National	**39.6**	**60.4**

Source: Energy Commission, 2011b

3. CURRENT SITUATION WITH REGARD TO SE4ALL GOALS

3.1 ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

3.1.1 Modern Energy for Thermal Applications

The demand for wood puts Ghana's forests under tremendous pressure and has severe consequences for the ecosystem as a whole. Deforestation rates in Ghana are amongst the highest in Africa, with current levels of wood-fuel consumption far exceeding forest growth. The charcoal production process contributes heavily to this deforestation and is responsible for high emissions of greenhouse gases such as carbon dioxide and methane. This is because charcoal is produced in simple earth-mound kilns with carbonisation efficiency below 20%, meaning that large volumes of wood are consumed to make it. An opportunity has arisen to encourage the deployment of efficient charcoal stoves to households in Ghana, reducing charcoal consumption and therefore alleviating the problems associated with its use.

Additionally, air pollution from cooking with solid fuel is a key risk factor in childhood acute lower respiratory infections (for example, pneumonia), as well as in many other respiratory, cardio-vascular and ocular diseases. In Ghana, exposure to indoor air pollution is responsible for the annual loss of 502,000 disability adjusted life-years (DALY). The DALY is a standard metric used by the World Health Organization (WHO) to indicate the burden of death and illness due to a specific risk factor. The WHO also estimates that exposure to indoor air pollution is responsible for 16,600 deaths per year in Ghana.

3.1.1.1 Promotion of LPG

In 1989, the Ministry of Energy embarked on a programme to promote the use of liquefied petroleum gas (LPG) as part of the Government's efforts to reduce deforestation of the country from the overdependence on woodfuels. The promotion targeted households, public catering facilities and small-scale food sellers. As a promotional strategy, 14.5kg and 5kg LPG cylinders were distributed freely to the public. Consumers were either given free cylinders on request or were given cylinders filled with gas, but they were required to pay for the cost of the gas only. Furthermore, to enhance fast distribution and delivery of LPG to consumers, the Ministry of Energy purchased and assigned pick-up trucks provided with 50 cylinders each to registered private individuals to retail LPG. The trucks operated "door-to-door" service to increase access and bring LPG closer to consumers conveniently. The promotional programme was extended to the educational institutions, hospitals and prisons, which benefitted from free plant and equipment installations. A fund, the LPG Fund was created with a levy placed on LPG purchases to fund the purchase and maintenance of cylinders, LPG tanks and kitchen equipment for institutions. The LPG Fund was used to finance the local component of the cost of constructing the Ghana Cylinder Manufacturing Company (GCMC) factory in Accra.

These initiatives were successful, increasing the annual consumption of LPG from 5,000 tonnes in 1990 to 34,000 tonnes in 1994. Annual LPG consumption LPG grew from 45,000 tonnes in 2000 to 220,000 tonnes in 2009 but dropped to 178,000 tonnes in 2010 due mainly to a long shutdown of the Tema Oil Refinery. In 2006, an estimated 10% of Ghanaian households used

LPG as the main source of fuel for cooking. More recent estimates by the Energy Commission suggest that approximately 40% of household are currently using LPG as the main cooking fuel.

The demand for LPG has grown considerably averaging over 40% between 2000 and 2010. The existing infrastructure at Tema Oil Refinery is inadequate to meet the present demand. The refinery is the only LPG production facility in the country and has daily production rate of 200-250 tonnes/day. This is a fraction of the daily demand of the country of about 1,000 tonnes. The refinery has a current storage capacity of 6,300 metric tonnes which is insufficient for the growing demand for the product by both commercial and domestic users. The situation that has resulted in intermittent severe shortages of LPG in the country. This has led to some households going back to the use of charcoal or at least using it as a back-up fuel for cooking.

The purpose of the LPG programme was defeated when taxi cabs and other commercial vehicles started patronizing LPG as a fuel for their cars and the levy was also scrapped in February 1998. The country's weekly consumption of LPG is currently, estimated at 4,000 tonnes with the transport sector accounting for about 37%. Commercial vehicle drivers have found LPG cheaper than other transport fuels due to higher price differential between LPG and gasoline. This price differential is mainly as a result of the subsidy component on LPG in the price build-up, which was designed for domestic users with the primary objective of helping households to meet their demand at an affordable price. The government currently spends about GH¢14 million subsidizing LPG every month and there are strong indications within government circles that there are plans to review LPG subsidy scheme because it is not benefiting only the intended beneficiaries, as well as the fact that the scheme was becoming unsustainable. In 1994, the Road Traffic (use of Liquefied Petroleum Gas) Regulations, 1994, LI 1592 was passed to regulate the use of LPG as fuel in vehicles. The enforcement of LI 1592 has been ineffective leading to the blatant abuse of the LPG subsidy by commercial vehicles.

Most second cycle schools, hospitals and prisons which embraced the LPG programme have also gone back to the use of charcoal and firewood for cooking because of supply difficulties. In 2006, the Household Energy Project (sponsored by the UNDP) also supported 22 schools to convert their kitchens to the use of LPG. After 6 months of use, the schools abandoned LPG because they found LPG more expensive than firewood.

The experiences gained in the LPG Promotion Programme since 1989 and also from recent developments provide a strong basis for developing a strategy towards the realization of the dual Government policy objectives of 50% access by 2015 and ensuring supply reliability.

3.1.1.2 Initiatives on Improved Firewood Stoves

Improved firewood stoves that have advantages of fuel savings and reduced indoor air pollution have been developed and promoted by the Institute of Industrial Research (of the Council for Scientific and Industrial Research – CSIR-IIR) and New Energy (an NGO). The promotion of the improved firewood stoves by the Institute of Industrial Research resulted in its adoption by more than 1,000 households in the Tumu District in the Upper-East Region. Enterprise Works (an NGO) and Toyola, a private sector stove manufacturer and wholesale supplier, have also been engaged in the development and promotion of various designs of firewood stoves (see Figure

3.1 and 3.2). However, the success of firewood stoves in terms of widespread use has been limited owing to poor interest of the target group - households in rural communities, which obtain firewood at minimal or no cost.

Figure 3.1: CSIR-IIR Improved Firewood Stove

Figure 3.2: Toyola Improved Firewood Stove

3.1.1.3 Initiatives on Improved Charcoal Stoves

Improved Charcoal Stove Initiative - Ministry of Energy

In the beginning of the 1990s, the Ministry of Energy undertook comprehensive field and laboratory tests on the *Ahibenso* stove (see Figures 3.3 and 3.4). These tests showed high levels of savings, adaptability and cooking performance of the stove. It also showed a high preference of the stove by charcoal users. 12,000 stoves were pre-financed by the Ministry of Energy and disseminated through comprehensive promotion through radio and television made. The Ahibenso programme development was funded by the World Bank and the government.

Figure 3.3: Traditional Charcoal

Figure 3.4: Ahibenso Improved Stove

Apart from one industrial producer set up by government, artisan production was also promoted through training, but financial support could not be sustained by government. The stove exists in the market in Accra but it is not sold in large numbers and sale outlets are few. The focus was on dissemination and acceptance of the stove by consumers and little attention was put on commercialisation and setting up sustainable credit facilities for artisans to purchase metal sheets and tools after the withdrawal of financial support of the government (Energica, 2009).

Enterprise Works Ghana Initiative

Since 2002, Enterprise Works Ghana *(EWG)* has focused on the manufacture and commercialization of consumer-oriented designed improved charcoal stoves that reduce indoor air pollution and use less fuel. EWG's Household Energy Program has been one of the most successful improved biomass cookstove program in Ghana. The stoves have high-efficiency, less cook time and low biomass fuel consumption thereby providing tremendous socioeconomic, environmental, and health benefits to stove users and their communities.

Since their stove manufacture and distribution began, EWG has sold over 480,000 stoves and has mentored manufacturers, distributor and retailers that are currently operating on a self-sustaining basis. The improved cookstove program is marketed under the brand name *Gyapa*, and it has helped households who use them to save on energy costs by enabling them to reduce their fuel consumption by up to 40% (see Figures 3.5 and 3.6). The EWG estimates that households have saved an average of US$37 per year with a total annual savings of US$3.6 million. Use of these improved stoves has also helped slow the rate of deforestation by reducing the consumption of charcoal and wood. Over the stoves' 3-year lifespan it is estimated that the equivalent of more than 27,606 hectares of forest may be conserved.

Figure 3.5: The Gyapa Stove

Figure 3.6: A Retail Shop displaying Traditional and Improved Stoves

According to the EWG, the *Gyapa* improved stoves significantly reduce smoke emission, substantially reducing harmful indoor air pollution that has been proven to increase illness and sometimes lead to premature deaths. The stove program has contributed towards employment throughout the stoves value chain, creating jobs for metal workers, ceramists, and retailers. The key sponsors of the EWG stove program at different stages have been the USAID, Shell Foundation and the Environmental Protection Agency of the USA.

Climate Care Initiative

The Ghana Stoves Project of Climate Care (an NGO) has also promoted the *Gyapa* stove. Carbon finance allows the stoves to be marketed at an affordable price, whilst building on manufacturing skills, marketing channels and the fuel supply chain. As at 2009, the project had distributed over 110,000 stoves. With respect to its Carbon Status, the project is under validation to the Gold Standard. The liners are made by a small group of accredited ceramicists who have received specialist training. The metal claddings are made by a further group of accredited manufacturers. Enterprise Works, the project partner of Climate Care in Ghana, provides training and quality control services, and distributes the stoves through a wide network of retailers. (Climate Care, 2009).

Toyola Stoves Initiative

The improved charcoal stove manufactured and marketed by Toyola Energy Limited, and indigenous private sector firm, is also based on the *Gyapa* design using a ceramic liner in a casing made from scrap metal. Toyola Energy Limited is owned by two Ghanaian entreprenurs who started up in 2006 with a loan from the Africa Rural Energy Enterprise Development (AREED) programme for pre-financing materials and for vehicles. This loan has been repaid and new loans have been obtained. The aim for 2007 was to manufacture and market 6,000 stoves, but sales of 20,000 stoves were reached. 30,000 stoves were manufactured and sold in 2008 and it was expected that sales would reach 50,000 stoves in 2011 with carbon financing.

Toyola has developed a home-grown marketing model that is hinged on improving access of households to energy-efficient cookstoves by operating a mobile stove delivery model that brings the products to the doorsteps of consumers in their communities. The process starts with education about the dangers of current practices and a discussion of available alternatives. A readiness to allow the customers to "test drive" the technology by leaving the product on sale or return basis helps to reduce initial objections and hesitations and promotes acceptance. The company offers credit barter financing to its customers so that they pay in convenient instalments over time from savings they make from using these improved technologies. This strategy has resulted in the sale of over 100,000 stoves in Ghana, with some exported to Burkina Faso, and Togo Republic. Selected satisfied users are appointed as sales agents in their communities and they earn commissions on their sale of the cookstoves.

Household Energy Project

In 2006, the UNDP assisted the Ministry of Energy to implement a Household Energy Project (HEP). The goal of the project was to enhance access to sustainable energy services for cooking in Ghana. A key objective of the project was to encourage the use of efficient charcoal and firewood stoves. Implementation of the project resulted in (i) development of a woodfuel policy, (ii) development of safety standards for LPG in the household and commercial sectors and (iii) implementation of pilot projects to test policy recommendations.

Specifically, the project introduced improved wood burning stoves made from metal in 22 schools in the Northern and Upper-East regions. Unfortunately, 80% of the stoves were abandoned after 2 months of use primarily because they were not suitable for preparation of most traditional staple foods. However, modified traditional mud stoves were more acceptable to the users.

3.1.2 Modern Energy for Productive Uses

The National Electrification Scheme was to be accompanied by an aggressive Productive Uses of Energy (PUE) programme. The nation's efforts under the PUE component of the NES over the past twenty (20) years can be summed up as follows:

- Organization of public forums on productive uses of electricity in newly electrified communities;
- Socio-economic study/ Productive Uses of Electricity in some districts Assessment of the feasibility implementation of productive use of electricity initiatives in the districts; and
- Development of a strategy for implementing a pilot project(s) to demonstrate the practicality and sustainability of productive uses of electricity.

According to some researchers only 50-60% of households with electricity in electrified communities are actually connected and most of these customers consume less than 50 kWh per month (Ministry of Energy, 2011). The low consumption rates are indicative of the fact that the use of electricity in these communities is predominantly for domestic lighting purposes only. It appears that the PUE programme component of the NES that was to have actively facilitated the generation of economic activity in the respective communities was not adequately pursued.

The further inference is that there is little direct contribution from electrification to economic activity in communities that have benefited from the Scheme. There has been a number of small to medium scale attempts by a number of nongovernment institutions. Most of these initiatives were intended as pilot or demonstration projects and required policy leverage for wider public and private sector buy-in for expanded impact and long-term sustainability. These projects were however, entirely outside the public sector so even the successful ones had very limited impact due to the absence of the necessary Government support to mainstream the ideas and concepts.

Productive uses of energy involve the utilization of energy – both electric and non-electric energy in the form of heat or mechanical energy - for activities than enhance income and welfare. These activities are typically in the sectors of agriculture, rural enterprise, health and education. Examples of such activities include pumping water for agriculture, agro-processing, lighting, information and communications, and vaccine refrigeration (see Figure 3.11). The promotion of the productive uses of energy is an important aspect in the design and implementation of rural energy projects.

Figure 3.7: Pumping underground water with electricity for irrigation

Source: Humado, 2011

In the Keta Municipality, for example, the selected PUE projects in the five communities were:

- Vegetable Processing Project (under the Presidential Special Initiative) for Anloga;
- Fish Cold Storage Facilities and Ice Production for Woe;
- Brick, Tiles and Ceramic Industry (under the Presidential Special Initiative) for Bomigo;
- Aquaculture and Vegetable Farming project (under the Eureka Program) for Lawoshime; and
- Salt Mining and Refinery (under the Presidential Special Initiative) for Afiadenyigba.

It was envisaged that these selected projects will provide jobs for the potential labour force which constitute 59.1% of the population and thereby help to stem the rural-urban drift. This would also engage a significant number of women who constitute the larger percentage of the labour force. The projects would also provide income for the populace; increase their spending levels with the attendant multiplier effects on the general development of these areas and the standards of living.

The vegetable processing facility would have a financing mix arranged among the main financiers – a project promoter from the private sector, supported with a loan (at a debt:equity ratio of 80:20) from a financial institution with facilitation by the District Assembly, Ministry of Food and Agriculture and the Ministry of Trade and Industry's President's Special Initiation programme. Development organizations such as the World Bank, UNIDO and other foreign investors would also be approached to support the funding of the project.

Owing to difficulties in the mobilization of capital, the proposed projects could not be implemented. However, taking advantage of the vast water resource in the Keta-Avu-Angor Lagoon Basin (open lagoons, rivers, creeks and wetlands), small-scale annual crop cultivation is already a main activity of the people. Vegetables (shallot, tomato, okra, chili pepper) are cultivated in three crop rotations per year on the sandy littoral under manual and mechanized irrigation using the water aquifers (Humado, 2011).

3.2 ENERGY EFFICIENCY vis-à-vis GOAL OF SE4ALL

The annual growth in the demand for firewood and charcoal in Ghana is estimated at 3% per annum. Electricity demand, on the other hand, is growing between 6% and 7% annually while consumption of petroleum products is estimated to increase at about 5% per annum (Energy Commission, 2010). Energy efficiency and conservation can help mitigate these high growth rates.

The losses in the production, transmission and use of energy are also high. System losses in electricity distribution are about 25%, with wastage in the end-use of electricity also estimated at about 30%. Reduction of losses in energy supply and more efficient use of energy would contribute to reduction in the demand for energy.

3.2.1 Some Initiatives on the Promotion of Energy Efficiency

3.2.1.1 Promotion of Compact Fluorescent Lamps

During the 2007 Energy Crisis, the Energy Commission coordinated the procurement and distribution of 6 million compact fluorescent lamps (CFLs) to urban, peri-urban and rural households as a load reduction measure to reduce the impact of the power shortages. All 6 million lamps were distributed and installed as a direct replacement of incandescent filament lamps.

This initiative resulted in the following savings:

- Peak Load Reduction of 124 MW (equivalent to the capacity of one new thermal plant);
- Reduction of 496,000 kWh per day, resulting in US$107,107 per day, or US$38,558million per annum; and
- Reduction of 116,000 tons of CO_2 per annum.

The penetration of CFLs in the country increased from 20% in 2007 to 79% in 2009 as a result of the free distribution of CFLs to the replace incandescent bulbs. This load reduction strategy to minimize the impact of the shortfall in hydropower generation won for the country the EE Global Visionary Award in 2010, as the first African country to undertake such an action (Energy Commission, 2010). Two factories have now been established to produce CFLs in Ghana.

Power Factor Improvement in Tertiary Institutions

As part of measures adopted by government to reduce recurrent expenditure, the Ministry of Energy embarked on installing Power Factor Correction equipment in five tertiary institutions. The first of the five to benefit was the University of Ghana, Legon where 26 capacitor banks were installed on transformers that serve the various halls and academic facilities of the University. The activity was implemented by the Energy Foundation on behalf of the Ministry of Energy. The contract for the supply and installation of equipment which was specified by the Energy Foundation was executed by AB Management & Agency Ltd, a local energy management firm and one of the few contract energy managers in the country. Equipment installation was completed in November 2005.

The first results of the effect of the installation on the electricity bills of the University appeared in December when the bill for the first full month after the installation was presented. The total cost of electricity to the University has reduced from an average of GH¢128,000 a month between October 2004 and November 2005, to a three-month average of GH¢64,300 in December 2005 and January 2006. In December 2004 the University paid a total of GH¢138,000 on electricity. The reduction has been mainly due to a reduction in Maximum Demand from 4,659kVA in November 2005 to 2,175kVA in December and further to 1,627kVA in January 2006 (see Figure 3.8). As a result of the installation Power Factor has improved from an average of 0.83 to 1. Power Factor Surcharge which averaged GH¢2,850 per month has been totally eliminated.

A remarkable achievement is the reduction in energy use and consequent cost. It is important to note that the University is supplied power at 11kV and is metered at a bulk meter point before power is distributed to the various transformers scattered throughout the campus. The installation of capacitors has reduced cable losses to such an extent that actual electricity consumption has reduced. It is important also to note that in December 2004, the University consumed 1,525,130 kWh of electricity as against 819,131 kWh in December 2005.

Compared to the electricity cost profile before the installation, the University of Ghana is saving an average of GH¢64,149 a month. This means that the cost reduction for the University of Ghana alone is enough to pay for the installations in all the five tertiary institutions in less than four months. The total cost of the installations in all the five institutions namely University of Ghana, Legon, University College of Education, Winneba, GIMPA, University of Cape Coast and KNUST was GH¢19,000.

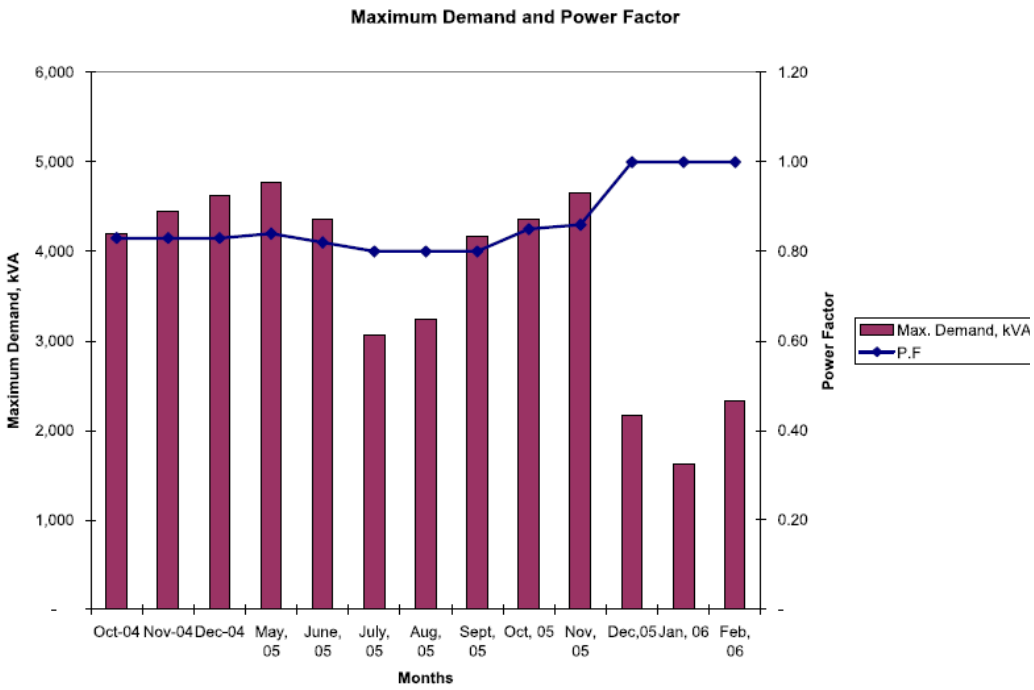

Fig. 3.8: Max Demand Reductions at the University of Ghana due to Improvement in Power Factor

The Energy Use Survey of the Energy Commission in 2011 revealed that over 80% of households across the country are using CFLs or ordinary fluorescent lamps (see Table 3.1).

Table 3.1: Share of Households using various Electric Lighting Devices by Regions and Locality

Region	% of Households using Incandescent Bulbs	% of Households using CFLs	% of Households using Fluorescent Lamps
Greater Accra	11.0	57.9	30.7
Eastern	15.4	88.9	46.3
Volta	12.1	90.2	44.3
Central	10.5	85.1	33.2
Western	8.3	89.5	39.5
Ashanti	9.3	89.2	26.0
Brong-Ahafo	5.4	96.1	21.2
Northern	23.3	79.5	36.6
Upper East	2.8	87.0	24.2
Upper West	4.9	77.0	21.7
Urban/Rural Households			
Urban	*9.7*	*84.8*	*36.0*
Rural	*12.5*	*81.4*	*28.5*
National	**10.8**	**83.5**	**33.1**

Source: Energy Commission 2011

There are various motivations to improve energy efficiency. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of implementing an energy efficient technology. Apart from the use of CFLs for lighting, improvements in energy efficiency may also be achieved by adopting a more efficient technology or personal practices such as switching off electrical appliance when not in use. The Energy Commission survey also observed that 81.5% of households have introduced one energy saving measure or the other (see Table 3.2).

Table 3.2: Type of Energy Saving Measure applied by Households

Type of Energy Saving Measure	% of Households applying Energy Saving Measure
Using energy saving bulbs	58.5
Switch appliance off when not in use	37.9
Ironing in bulk	1.2
Reduced number of appliance	1.3
Use of appliance with lower power rating	0.9
Use of stabilizer	0.2
Total	**100**

Source: Energy Commission, 2011

3.3 RENEWABLE ENERGY vis-à-vis GOAL OF SE4ALL

Ghana is well endowed with renewable energy resources particularly biomass, solar, wind energy resources, and to a limited extent, mini-hydro. The development and use of renewable and energy resources have the potential to ensure Ghana's energy security and also mitigate the negative climate change impact of energy production and use, as well as solve sanitation problems.

3.3.1 Biomass

Direct woodfuels have a total stock of about 832 million tonnes. Timber logging utilise 2.0 - 2.7 million m^3 per annum, generating 1.0-1.4 million m^3 of logging residues on an annual basis. These residues include slabs, edgings, off cuttings, sawdust, peeler cores and residues from plywood manufacturing. Sawmill and ply-mill residues are most concentrated in the Kumasi area and large-scale furniture mills are in Accra, with several smaller-scale furniture producers distributed throughout the country. There is also potential of wood residues from construction of roads and skidding trails in the forest for the haulage of harvested timber, wood residues from forest clearings for agriculture and wood from surface mining sites. In addition to logging there are several other potential reserves of biomass. Total land area under tree plantation is estimated at 75,000 ha. Trees of poor form, which will not be suitable for commercial sale, that are removed from these plantations together with the residues from the harvesting of lumber grade trees could also be reckoned as potential sources of energy.

Diseased coconut trees as well as, over-matured coconut and oil palm trees could be very good fuel sources for the production of energy. Analysis of the physical characteristics of trees reveals that woodfuel from the savannah zone have higher calorific values than those in the closed high forest zone of central Ghana. Thus, the trees from the savannah zone which are not suitable for processing into lumber or veneer are very suitable for energy use in the form of charcoal or firewood.

3.3.2 Solar Energy

Solar radiation and sunshine duration data has been collected by the Ghana Meteorological Services Agency (MSA) for over 50 years. The daily irradiation data has a probable error of 15%. Currently the Mechanical Engineering Department at Kwame Nkrumah University of Science and Technology (KNUST) is measuring hourly global and diffuse irradiance using standard instruments that have a probable error of 5%. The average duration of sunshine varies from a minimum of 5.3 hours per day at Kumasi, which is in the cloudy semi-deciduous forest region, to 7.7 hours per day at Wa, which is in the dry savannah region. The monthly average solar irradiation in different parts of the country ranges between 4.4 and 5.6kWh/m^2 /day (16-20 MJ/m /day) (see Figure 3.9).

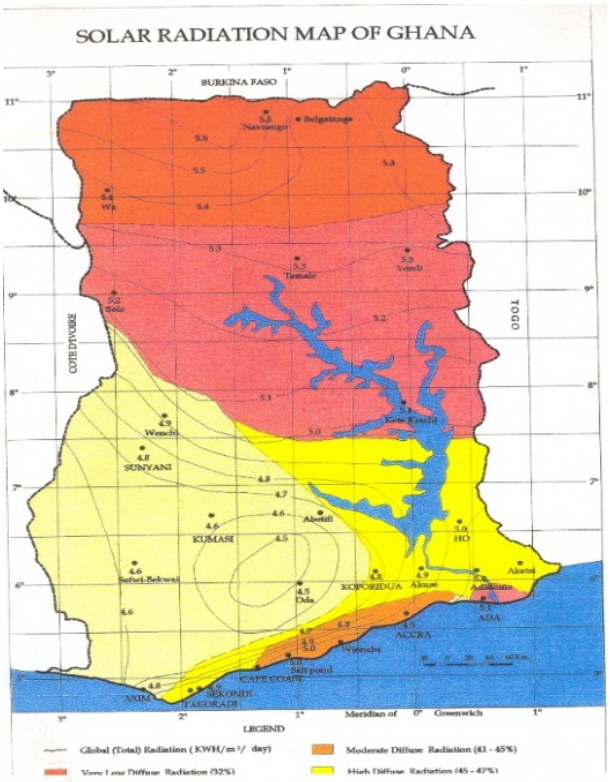

Figure 3.9: Solar Resource Potential of Ghana

Source: Ministry of Energy, 2011

The northern regions and the northern parts of Brong-Ahafo and Volta Regions receive very high radiation levels with monthly average of between 4.0 and 6.5kWh/m^2/day. The area experiences one major rainy season between July and September. The Harmattan is prevalent between November and February. Ashanti, parts of Brong-Ahafo, Eastern, Western and parts of Central and Volta regions have monthly average radiation level of 3.1 - 5.8 kWh/m^2/day. The water vapour in the atmosphere causes greater absorption and scattering producing high levels of diffuse radiation. Greater Accra, and the coastal regions of Central and Volta Regions have monthly average radiation levels ranging from 4.0 – 6.0 kWh/m^2/day.

3.3.3 Wind Energy

Ghana has about 2,000MW of raw potential for wind energy as shown in the Wind Energy Resource Map of Ghana in Figure 3.10) Satellite data provided by the National Renewable Energy Laboratory of USA under the UNEP SWERA Project indicates that the annual average wind speed along the Ghana-Togo border is above 8 m/s. It is currently reliably projected that over 300 MW installed capacity of wind farm could be established at the coastal part to generate over 500 GWh

to supplement the nation's energy supply. The wind direction in the country is predominately southwest.

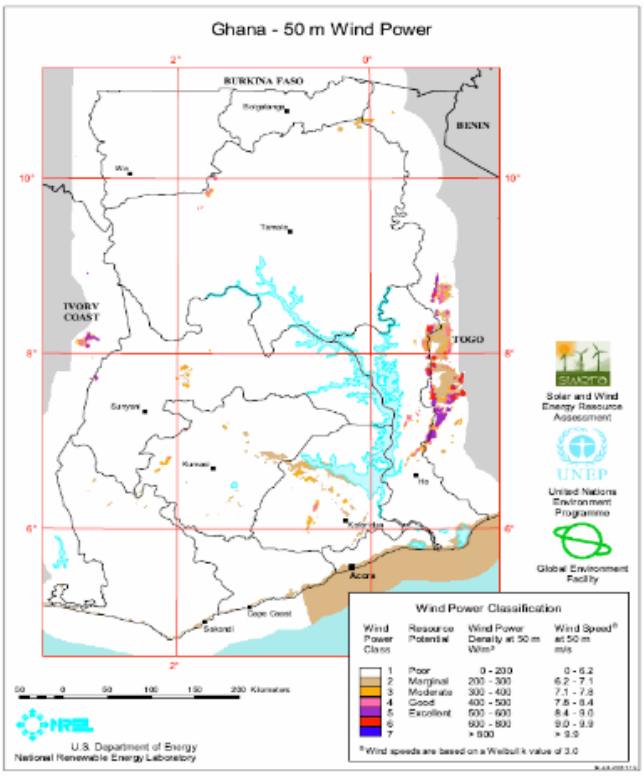

Figure 3.10: Wind Resource Potential of Ghana

Wind resource measurement activities in Ghana dates back to 1921 when the Meteorological Service Agency (MSA) started collecting wind direction data in its Accra station. In 1936, the Agency installed an anemometer to measure wind speed and direction at 2 metres above ground level in 22 synoptic stations located all over the country. The data was collected for agro-meteorological purposes and not for wind energy application. The wind data indicated an average wind speed of approximately 1.4m/s with the highest average speed of 3m/s experienced along the eastern coastline of the country. Wind speed data collection for energy purposes was initiated in 1999. From this period wind resource measurements have been undertaken at 13 sites along the coast at 12 metres or more above ground level.

3.3.4 Mini-Hydro

There are 22 exploitable mini-hydro sites in the country with total potential between 5.6MW – 24.5MW. The mini-hydro sites are shown in Fig 3.11. Ghana has two large hydroelectric plants, Akosombo and Kpong, on the Volta River with a total installed generation capacity of 1,180 MW. Currently the Bui hydroelectric plant of capacity 400MW is being developed on the Black Volta. Hydroelectric plants of over 10 MW are possible on 17 sites on the Black Volta, White Volta, Oti River, Tano River, Pra River and Ankobra River.

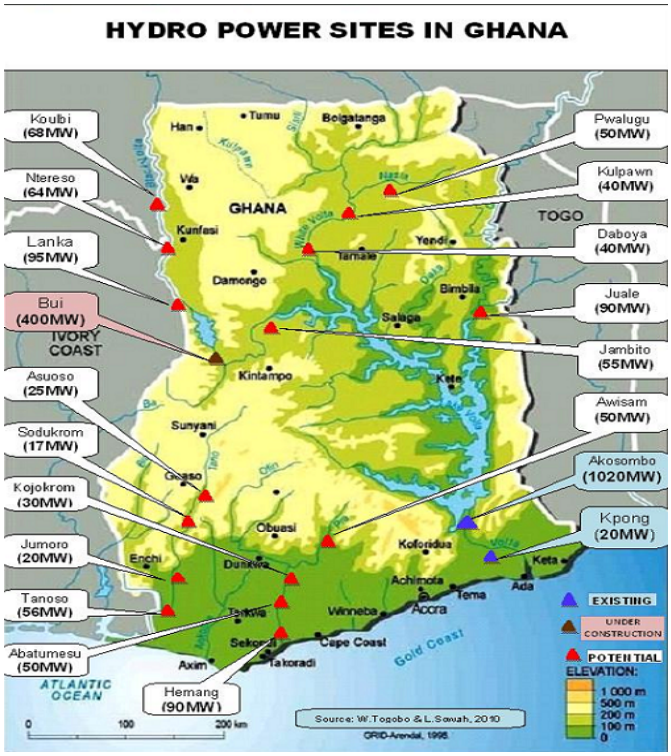

Figure 3.11: Hydropower Sites in Ghana

3.3.5 Agro-Waste

There are two types of agro-fuels: crop residues and animal waste. Agriculture is a major industry in Ghana, and consequently, large amounts of by-products/residues that can be used for energy production are generated. It has been estimated that there is 553,000 tonnes of maize cob and stalk produced with a potential energy of 17.65 - 18.77 MJ/kg and 19 tonnes of paddy rice husks with a potential energy of 16.14 MJ/kg. As well, 193,000 tonnes of oil palm shells, 136,000 tonnes of sorghum stalks, 150,000 tons of millet stalk and 56,000 tonnes of groundnut shells are also produced. As a result, the estimated energy that could be harvested from various products in the year 2000 are: maize 32,513.7 TJ/kg, rice 7,076.6 TJ/kg, cassava 5,7720.1 TJ/kg, yam 23,943.9 TJ/kg, groundnuts 1,045.3 TJ/kg and cocoyam 11,570.6 TJ/kg.

3.3.6 Municipal Waste

Municipal waste is generated in large quantities. For example, Kumasi and its suburbs generate up to 1,600 tonnes daily while Accra and its environs generate up to 2,500 tonnes. In general, municipal waste generation in the metropolitan centres varies from 600-800 tonnes per day.

3.3.7 Some Renewable Energy Initiatives

3.3.7.1 Co-generation

There is potential for co-generation use in many sectors especially in the wood processing and vegetable oil industries. Some biomass fired co-generation projects were implemented in the past. Two key factors have hindered the exploitation of co-generation especially in the wood processing industry. First, most of the potential co-generators have access to cheaper power supply from the grid. Second, until the development of the Renewable Energy Bill, there were virtually no financial or fiscal incentives neither were there regulatory requirements that would encourage them to

generate and sell electricity to the grid. Table 3.3 shows biomass-fired co-generation plants in Ghana.

Table 3.3: Biomass-fired co-generation plants in Ghana

Plant Location	Installed Capacity (kW)	Average annual production (GWh)
Kwae Oil Palm	420	1.50
Juaben Oil Palm	424	1.50
Benso Oil Mill	500	1.90
Twifo Oil Palm	610	2.10

Source: Energy Commission, Ghana

3.3.7.2 Biogas Technology

The biogas technology could be used for cooking in households, direct lighting, small power generation, and bio-sanitation. The use of biogas technology for cooking in households and small power generation has not been successful. Most of the household biogas plants built in the country have been abandoned. The average cost of electricity generated from biogas is about 51cents/kWh compared to other sources such as diesel and other petroleum based generation. A very interesting development in the use of biogas technology however has been in the area of bio-sanitation for schools, slaughter-houses, hospitals etc.

3.3.7.3 Solar PV

Over 4,500 solar systems have been installed in over 89 communities throughout the country. This systems include: Solar Home System for basic house lighting, radio and TV operation; Solar Hospital System for vaccine refrigeration and lighting; Solar School System for classroom lighting and television for Presidential Special Initiative on distance education; Solar Streetlight System for lighting general meeting points, such as markets, lorry stations, water supply points and important busy paths/roads requiring visibility; Solar Water Pumping System for the provision of water and irrigation; Solar Battery Charging System for charging automotive batteries for operating TV and radios in rural communities; Solar System for communication and centralized solar system for providing AC power into the grid (See Fig 3.12).

Fig 3.12: Solar System for Communication
Source: Energy Commission, 2011

Three grid connected solar panels have been deployed at Energy Commission (4.25 kW), Ministry of Energy (50.0 kW) and Kwame Nkrumah University of Science and Technology (4.25kW). The total installed capacity of solar PV is about 1.0 MW and generates approximately 1.8GWh of electricity per annum (See Table 3.4). There have been three major projects that have sought to electrify rural communities with solar energy. There are the Renewable Energy services Project which provided stand-alone solar PV systems for thirteen communities in the East Mamprusi district and Tenzu; the Ministry of Energy off-grid solar project that electrified 24 rural communities with assistance from the Spanish Government; and the Renewable Energy Development project that was financed by the Danish International Development Agency.

Table 3.4: Solar PV Installations in Ghana (kW)

SOLAR PV SYSTEMS	INSTALLED CAPACITY	GENERATION
Rural home system	450	0.70 – 0.90
Urban home system	20	0.05 – 0.06
School system	15	0.01 – 0,02
System for lighting health centres	6	0.01 -0.10
Vaccine refrigeration	42	0.08 – 0,09
Water pumping	120	0,24 – 0.25
Telecommunication	100	0.10 – 0.20
Battery charging system	10	0.01 – 0.02
Grid connected systtem	60	0.10 – 0.12
Solar streetlights	10	0.04 – 0.06
TOTAL	**853**	**1.34 – 1.82**

Source: Energy Commission, 2011

3.3.7.4 Solar Water Heaters

Solar Water Heaters are assembled by local companies, such as Deng Ghana Ltd. They are currently installed in residential dwellings, health institutions, hotels, restaurants and laundries. The majority are in rural health posts. In recent times the use of solar water heaters in hotels are increasing rapidly with the African Regent Hotel, a 4 star hotel in Accra, meeting its hot water requirement from this system. Over 95% of the solar water heaters that have been deployed in the country are imported. Fig 3.13 shows a sample of solar water heaters sold in Ghana.

Fig 3.13: Solar Water Heater sold on the market
(Source: Energy Commission, Ghana)

4. CHALLENGES AND OPPORTUNITIES FOR ACHIEVING SE4ALL GOALS

4.1 INSTITUTIONAL AND POLICY FRAMEWORK

4.1.1 Energy and Development

Over the years, Ghana has pursued several policies and programmes to accelerate the growth of the economy and raise the living standards of the people. These include Ghana Vision 2020: The First Step (1996-2000); the First Medium-Term Plan (1997- 2000); Ghana Poverty Reduction Strategy (2003-2005); and the Growth and Poverty Reduction Strategy (2006-2009). Under these strategic programmes, substantial progress was made towards the realisation of macro-economic stability and the achievement of poverty reduction goals.

The First Medium-Term Development Plan (1997-2000) based on Vision 2020 focused on the following priority areas: Human Development, Economic Growth, Rural Development, Urban Development, Infrastructure Development, and an Enabling Environment. GPRS I sought to restore macroeconomic stability and reduce the incidence of poverty by focusing on the following themes: Production and Gainful Employment, Human Resource Development and Basic Services, Special Programmes for the Poor and Vulnerable, and Governance. Across these themes, five areas were selected for priority action: Infrastructure, Rural Development based on Modernized Agriculture, Enhanced Social Services, Good Governance, and Private Sector Development.

The GPRS II placed emphasis on growth as the basis for sustained poverty reduction “so that Ghana can achieve middle-income status within a measurable planning period”. Its thematic areas were: Continued Macroeconomic Stability, Private Sector Competitiveness, Human Resource Development, and Good Governance and Civic Responsibility.

The current medium-term development policy framework, the Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013 seeks to accelerate employment creation and income generation for poverty reduction and shared growth. The GSGDA is anchored on the following themes:

- Ensuring and sustaining macroeconomic stability;
- Enhanced competitiveness of Ghana’s private sector;
- Accelerated agricultural modernisation and natural resource management;
- Oil and gas development;
- Infrastructure, energy and human settlements development;
- Human development, employment and productivity; and
- Transparent and Accountable Governance.

The major thematic areas that relate most directly to energy access are oil and gas development; and infrastructure, energy and human settlements development. The key areas of policy focus in

the medium to long-term for the oil and gas sub-sector are: employment creation; protecting the environment; revenue management and transparency; diversification of the economy; capacity development; and increasing access to petroleum products. Under Infrastructure, energy and human settlements development, the key areas of policy focus for the medium-term are: transport infrastructure; energy and energy supply to support industries and households; science, technology and innovation; information and communication technology development; human settlements development; recreational infrastructure; and water, environmental sanitation and hygiene.

4.1.2 Energy Policies and Strategies

Over the years, Ghana has pursued several policies and programmes to accelerate the growth of the economy and raise the living standards of the people. These include Ghana Vision 2020: The First Step (1996-2000); the First Medium-Term Plan (1997- 2000); Ghana Poverty Reduction Strategy (2003-2005); and the Growth and Poverty Reduction Strategy (2006-2009). Under these strategic programmes, substantial progress was made towards the realisation of macro-economic stability and the achievement of poverty reduction goals.

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The Vision of Ghana's Energy Sector, as presented in the "Energy Sector Strategy & Development Plan, 2010" is therefore "to ensure availability of and universal access to energy services and for export by 2020."

With the context of current national development strategies, the medium-term energy policy aims at ensuring secure and reliable supply of high quality energy products and services for all sectors of the economy. The energy policy focuses mainly on: energy supply to support industries and households; electricity and thermal energy; renewable energy; nuclear and geo-thermal energy;

energy efficiency and conservation; regulatory environment; mobilization of investment for energy sector development; building human resource capacity and research & development, among others.

4.1.3 Other Relevant Policies

Other relevant policies are include:

- Food and Agriculture Sector Development Policy (FASDEP II)
- Irrigation Policy
- Industrial Policy
- Health Policy
- Science, Technology and Innovation Policy
- Environmental Policy

4.1.3.1 Food and Agriculture Sector Development Policy (FASDEP II)

The current Food and Agriculture Sector Development Policy (FASDEP II) was developed in 2007 by the Ministry of Food and Agriculture in 2007, as a follow-up of FASDEP I that was developed in 2002. FASDEP II emphasises the sustainable utilization of all resources and commercialization of activities in the sector with market-driven growth in mind. It targets selected commodities for food security and income diversification, especially of resource poor farmers. It also emphasizes the enhancement of productivity of the commodity value chain, through the application of science and technology, with environmental sustainability. It indicates that greater engagement of the private sector and collaboration with other partners will be pursued to facilitate implementation of policies.

The FASDEP II mentions energy availability and costs among the cross-cutting constraints in the food and agriculture sector, together with gender inequality and discrimination against women as well as access to land and finance. The policy document indicates that the cost and demand for energy (fossil fuel, electricity) in all sectors of the economy is growing rapidly (growth in demand for electricity estimated at 7% per annum), with dire consequences for agricultural production and processing. There is widespread use of energy inefficient agricultural machinery and equipment. Potential of alternative energy sources (renewable energy) in the sector is largely unexplored due to inadequate research and knowledge. In the case of electric power, the single-phase electricity supply system in rural areas is not suitable for agro-processing and related industries, which should be equipped by three-phase powered machines.

The policy document further states that though a key instrument for encouraging private sector investment into the sector is tax exemptions, these tax incentives have not been effective because of other constraints such as high cost of energy and poor infrastructure. The policy objective for irrigation development is to enhance production potential of existing schemes by raising productivity of irrigation water from 30% to 80% in a ten year period (by 2018). The strategies to be pursued includes the development of alternative ways of water delivery for irrigation schemes to reduce operational cost associated with energy.

4.1.3.2 Irrigation Policy

By 2003, the Ghana Irrigation Development Agency (GIDA) had 22 irrigation schemes under its jurisdiction covering about 14,700 ha of which 60% were developed and about 9,000ha actually put under irrigation. In many schemes the rates of utilization are low due to poor operation and maintenance of the facilities. The Government plans to add a total irrigable area of 500,000ha or more.

The National Irrigation Policy, Strategies and Regulatory Measures Irrigation Policy was formulated in 2011, with the goal "to achieve sustainable growth and enhanced performance of irrigation contributing fully to the goals of the Ghanaian agriculture sector". The specific targets of the policy are: i) national food security; ii) intensified and diversified production of agricultural commodities; iii) increased livelihood options; iv) optimum natural resource use; v) reduced negative environmental impacts; and vi) expanded investment space for irrigated production.

The policy addresses the problems, constraints and opportunities, which cut across the whole irrigation sub-sector; and specifically for informal, formal and commercial irrigation. It will be complemented with a strategic framework to be called National Irrigation Development Master Plan (NIDMAP) to specify how the strategies in this document will be implemented with the aim to put an area of 500,000 ha under irrigation in the medium to long term. The implementation of the proposed NIDMAP could be enhanced with improved access to modern energy services to rural communities that are engaged in agriculture.

4.1.3.3 Industrial Policy

Ghana's Industrial Policy was developed in 2011, within the context of Ghana's socio-economic growth through transformation into an industry-driven economy capable of delivering decent jobs with widespread, equitable and sustainable growth and development. The Policy is designed to promote increased competitiveness and enhanced industrial production, with increased employment and prosperity for all Ghanaians. It also seeks to promote a broader range of fair-priced, better quality products for the domestic and international markets. The key development objectives of the Industrial Policy are: i) to expand productive employment in the manufacturing sector; ii) to expand technological capacity in the manufacturing sector; iii) to promote agro-based industrial development; and iv) to promote spatial distribution of industries in order to achieve reduction in poverty and income inequalities.

The policy recognises that the provision of adequate, efficient and cost-competitive electricity and water supplies is a pre-requisite for accelerated industrial development. There is therefore the need to ensure reliable and sustainable supply of electricity and water to industry. In this context, the policy prescribes that Government will: i) ensure that industry's requirements of electricity and water are met at competitive prices and in an environmentally sustainable manner; ii) encourage private sector participation in the supply of electricity and water; and iii) draw up and implement energy and water efficiency and conservation programmes.

4.1.3.4 Health Policy

The Health Policy was formulated in 2006, with the ultimate goal "to ensure a healthy and productive population that reproduces itself safely". The goal of the health sector will be achieved through pursing three interrelated and mutually reinforcing objectives: i) to ensure that people live long, healthy and productive lives and reproduce without risk of injuries or death; ii) reduce the excess risk and burden of morbidity, mortality and disability, especially in the poor and marginalized groups; and iii) reduce inequalities in access to health, populations and nutrition services and health outcomes.

The objectives, concerns and challenges in the health sector are to be addressed through simultaneous action in seven priority areas: i) Promoting healthy lifestyles and healthy environments; ii) Providing health, population and nutrition services; iii) Investing equitably in capacity development of the health sector; iv) Promoting the use of Information for planning and management of the health sector; v) Ensuring sustainable and equitable financing; vi) Promoting a local health industry; and vii) Ensuing good governance and partnership. The priority areas of

"providing health, population and nutrition services" and "promoting the use of Information for planning and management of the health sector," in particular, could be enhanced with improved access to modern energy services to rural communities.

4.1.3.5 Science, Technology and Innovation Policy

The Science, Technology and Innovation Policy (STIP) was formulated in 2009, with the goal to achieve national development goals for poverty reduction, competitiveness of enterprises, sustainable environmental management and industrial growth". The objectives of STIP: i) to facilitate mastering of scientific and technological capabilities; ii) to provide the framework for inter-institutional efforts in developing STI and programmes in all sectors of the economy to provide the basic needs of the society; iii) to create the conditions for the improvement of scientific and technological infrastructure for research and development and innovation; iv) to ensure that STI supports Ghana's trade and export drive for greater competitiveness; and v) to promote a science and technology culture.

In order to achieve these objectives, the Policy seeks to facilitate the implementation of sectoral policies, programmes and strategies by the respective sectors on the basis of the STIP. The key sectors include Food and Agriculture, Health, Education, Environment, Energy, Trade, Industry, Natural Resources, Human Settlements and Communications.

The sectoral objectives on energy under the STIP are: i) to ensure the supply of sustainable, affordable, safe and reliable energy for domestic and industrial use; and ii) to provide an appropriate mix of energy sources. The key strategies to be pursued are: i) Promote a research and development programme relating to alternate energy sources such as solar energy, biomass, wind and other renewable energy sources to supplement the current traditional energy sources; ii) Facilitate efforts to acquire and adapt sustainable safe and economical energy technologies for national development; iii) Support research aimed at upgrading hydropower energy production technology; iv) Promote research and development efforts aimed at popularization and dissemination of energy technology for rural development; v) Promote public support for energy conservation and encourage private investment in energy technologies; vi) Encourage community investment and ownership of energy systems e.g. solar farms, windmills and biomass plants; vii) Exploit the utilization of nuclear energy resources for domestic and industrial use; and viii) Develop an integrated petrochemical industry to respond to the oil and gas industry.

4.1.4 Policy Oversight and Institutional Framework

The Ministry of Energy (MoE) has the mandate on behalf of Government to ensure a high performing energy sector to underpin national economic growth. The MoE therefore is responsible for formulating, coordinating, monitoring and evaluating policies, programmes and projects for the power sub-sector in particular and the energy sector in general. MoE is also the institution charged with the implementation of the National Electrification scheme (NES) which seeks to extend electricity to all communities in the long term. The structure of the electricity sector is illustrated in Fig. 4.1.

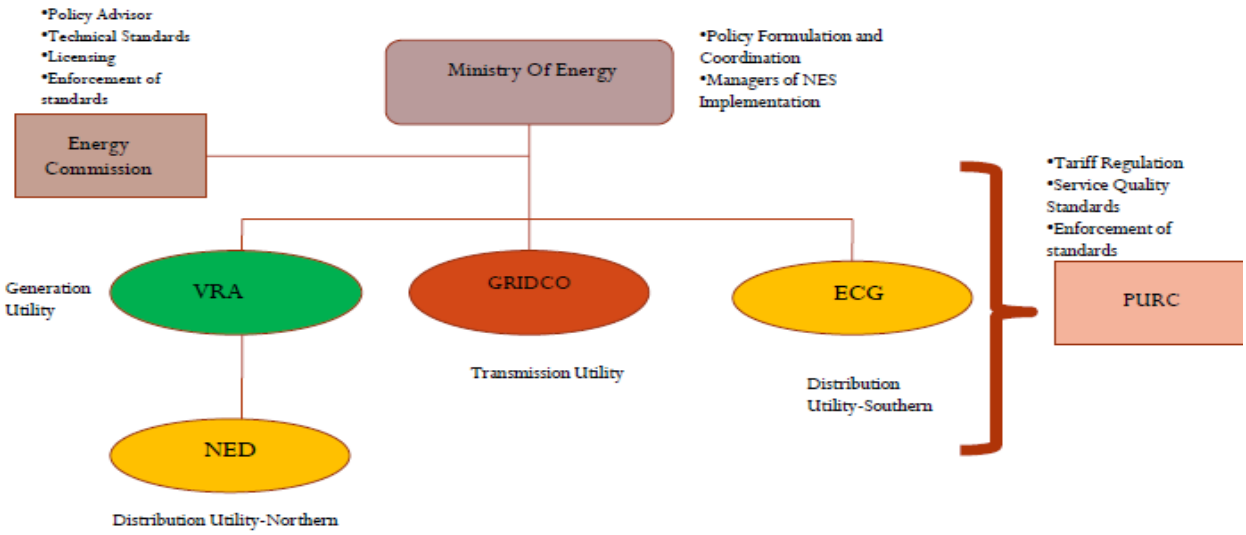

Figure 4.1: Structure of the Regulated Electricity Sector of Ghana

4.1.5 Energy Governance

The power sector in Ghana has an unbundled structure with the functions of power generation, transmission and distribution being performed by separate entities, coordinated by the Ministry of Energy. One of the objectives in adopting this sector structure was to encourage private participation and market competition in the generation business towards providing minimum cost electricity supply to citizens. The transmission function is however, performed by a designated transmission utility as an independent system operator (ISO) to provide nondiscriminatory access to all market participants. The distribution function is performed by licensed entities that have been granted concession areas. Whereas the arrangements between the operating entities are in general governed by contract and electricity regulations, the provision of electricity services to the public by these utilities are in addition subject to an independent regulator.

The operating entities in the electricity sector in Ghana provide the needed infrastructure facilities for the implementation of the National Electrification Scheme. The functions of these institutions and the infrastructure they provide are summarized below, under the categories Power Generation, Power Transmission, Power Distribution and Regulation.

4.1.5.1 Power Sub-Sector Institutions

Power Generation

Volta River Authority (VRA), a state-owned power generating utility, owns the Akosombo and Kpong Hydro Power stations and the Takoradi Thermal Power Plant (TAPCO), situated at Aboadze. The VRA is also a minority joint-venture partner with TAQA, a private sector company, in the Takoradi International Power Company (TICO) which owns a thermal plant, also located at Aboadze. VRA has a total installed electricity generation capacity of 1960 MW. This is made up of the two hydroelectric plants on the Volta River, with installed capacities of 1020 MW and 160 MW at Akosombo and Kpong generating stations, respectively, and complemented by the 330 MW Combined cycle plant (TAPCO) at Aboadze, near Takoradi. The 220 MW TICO plant, also located at Aboadze is currently operated in a simple cycle mode. The VRA has also developed a number of plants in Tema. These include a 110 MW Tema Thermal 1 Power Plant, an 80 MW Mines Reserve Plant, both commissioned in 2008; and, a 49.5 MW Tema Thermal 2 Power Plant commissioned in 2009.

Bui Power Authority (BPA) is another state-owned institution charged with implementation of the 400 MW Bui Hydroelectric Power Project. The first unit of 133 MW is scheduled for commissioning by the end of 2012. The total installed capacity of 400 MW will be commissioned by 2013.

Independent Power Producers (IPPs): The ***220 MW TICO plant***, located at Aboadze, currently operated in a simple cycle mode was the first Independent Power Producers (IPPs) to be established in Ghana. The TICO plant is owned by TAQA, a private sector company in a joint venture with the VRA as the minority partner. The ***220 MW Sunon-Asogli Plant*** located at Tema is another IPP which commenced operation in 2010. About six (6) other prospective Independent Power Producers (IPPs) have been licensed to build, own and operate power plants. These IPP efforts are at various stages of development and would translate into a total additional capacity of about 1,305 MW if and when they are fully commissioned.

Power Transmission

Ghana Grid Company (GRIDCo) is a state-owned entity that has the exclusive mandate to operate the National Interconnected Transmission System (NITS) as an Independent System Operator (ISO) and also to be the Market Administrator for the Electricity Market. The NITS comprises of all electricity plant and equipment within the borders of Ghana that function or are operated at any voltage higher than 36kV as well as any associated feeder or supply equipment that are for shared or common use. The National Interconnected Transmission System (NITS) is made up of over 4000 kilometers of high voltage transmission lines operating at 161 kV and 69 kV and the interconnection to La Cote d'Ivoire at 225 kV. The recently commissioned and ongoing implementation of 330kV projects will see 330 kV replacing 161 kV as the primary transmission voltage. The transmission lines are linked by 43 primary substations with total installed transformer capacity of 2630 MVA. Electricity supply voltage is reduced at these substations to 34.5 kV, 11 kV and 6.6 kV for supply to bulk supply customers and/or for onward distribution to end-users. The Ghana power network is also interconnected with the power grids of neighboring La Cote d'Ivoire (CIE), Togo and Benin (CEB).

Power Distribution

Electricity Company of Ghana Limited (ECG), a state-owned company, distributes electricity and presently serves a customer population of about 1.8 million in six regions of Ghana, namely; Western, Ashanti, Volta, Central, Eastern and Greater Accra. ECG has an installed transformer capacity of 1761 MVA and operates an extensive 33 kV and 11 kV medium voltage (MV) network and bulk supply substations (BSPs). ECG also owns and operates primary 33/11 kV transformer and switching substations, 33/0.415kV and 11/0.415 kV secondary transformer substations, 33 kV, 11 kV medium voltage (MV) and 415V low voltage (LV) lines.

Northern Electricity Department (NED): The VRA, through its distribution agency, the Northern Electricity Department (NED), is the sole distributor of electricity in the Brong-Ahafo, Northern, Upper East, Upper West, and parts of Ashanti regions of Ghana. NED has a customer population of 300,000 and a load demand of about 120 MW.

Regulatory Bodies

Public Utilities Regulatory Commission (PURC) was established in 1997 as an independent body with responsibility for the commercial regulation and oversight over the provision of electricity and water services by public utilities to consumers. The PURC's key tasks are to:

- Provide guidelines for rates to be charged for the provision of utility services
- Examine and approve water and electricity rates
- Protect the interest of consumers and providers of utility services
- Monitor and enforce standards of performance for provision of utility services
- Promote fair competition among public utilities
- Receive and investigate complaints and settle disputes between consumers and public utilities
- Advise any person or authority in respect of any public utility.

The Commission has issued two regulations, namely; the Public Utilities (Termination of Service) Regulations 1999, LI 1651 which set out the circumstances under which utility service to consumers may be terminated, and the Public Utilities (Complaints Procedure) Regulations 1999, LI 1651 which specifies the procedures by which any person (utility or consumer) may lodge a complaint with the commission.

The Energy Commission (EC) is another state institution, which is responsible for the regulation, management, development and utilization of energy resources in Ghana. The EC is the licensing authority for the generation, transmission, wholesale supply, distribution and sale of electricity and natural gas. The EC is also responsible for enforcing performance standards for all utilities in the Energy Sector. The Energy Commission provides leadership and collaborates with its clients, the leading energy producers, to effectively and efficiently create an enabling environment for excellence and fair competition in energy service delivery. As a regulatory body the Energy Commission promotes the development of standards for energy efficiency for appliances and in collaboration with other agencies enforces the energy efficiency requirements for appliances. This it has done through the enactment of LI 1815, namely Energy Efficiency Standards and Labeling (Non-ducted Air Conditioners and self-ballasted Fluorescent Lamps) Regulations, 2005. The Commission has also enacted the Electricity Distribution and Supply (Technical and Operational) Rules 2005 (LI1816) which specifies rules of practice for electricity distribution service providers.

4.2 STRATEGIES AND PLANS

4.2.1 Universal Access to Electricity

Electricity accounted for 8.4% of total national energy consumption in 2008. It is largely used in the residential sector, accounting for about 47% of total electricity consumed in the country. Electricity is also the dominant modern energy form used in the industrial and service sectors accounting for 65.6% of modern energy used in the two sectors of the national economy.

Ghana has an installed capacity of 1960MW made up of hydro and thermal facilities. Electricity demand which is currently 1400MW is growing at about 10% per annum. It is estimated that Ghana requires capacity additions of about 200MW to catch up with increasing demand in the medium to long term. The existing power plants are unable to attain full generation capacity as a result of limitations in fuel supply owing to rising fuel prices and uncertainty in rainfall and water inflows into the hydroelectric power facilities. In terms of Universal Access to Electricity, Ghana has set itself

the target of achieving Universal Access to Electricity by the year 2020, in line with its National Energy Strategy of 2010. As at 2008, 66.7% national coverage had been achieved, covering 4,070 electrified communities with a total population of 16 million. About 82,000 communities, covering 8 million people, remained un-electrified. As at 2011, national coverage had risen to 72% (See Figure 4.2 and Table 4.1).

The goal of Government is to ensure that those underserved regions with access rates below the national average are brought up to the national average and even beyond through increased investment in electrification projects. Generally, Government is pursuing vigorously the policy to extend the reach of electricity supply to all parts of the country by the year 2020. The target is to increase the access rate to 80% by the year 2015, mainly through the large number of on-going projects under the NES. Figures 4.3 and 4.4 show the Historical and Projected Peak Demand and Installed Electricity Generation Capacity Mix, respectively.

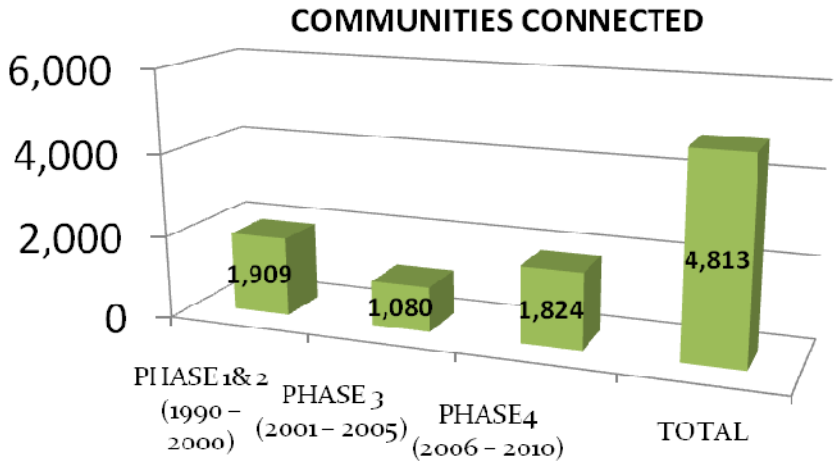

Figure 4.2: Communities with Electricity Connection
Source: Ministry of Energy, 2011

Table 4.1: Access to Electricity in the Regions of Ghana (Mid-2010)

Region	**Accessibility Rate**
Greater Accra	97%
Central	81%
Eastern	70%
Volta	65%
Upper East	44%
Ashanti	82%
Brong-Ahafo	67%
Western	68%
Northern	50%
Upper West	40%
National Average	**72%**

Source: Ministry of Energy, 2011

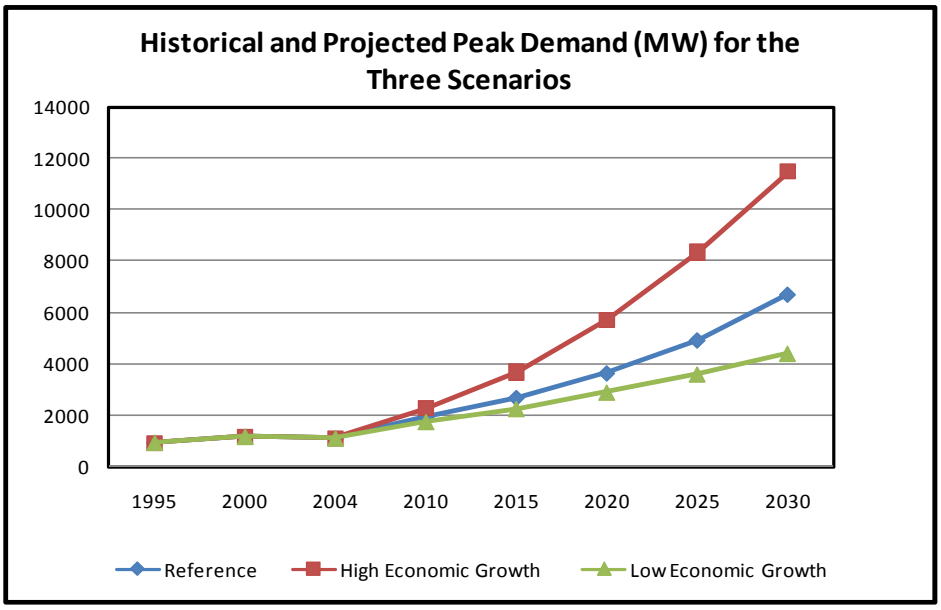

Figure 4.3: Historical and Projected Peak Demand
Source: Ministry of Energy, 2011

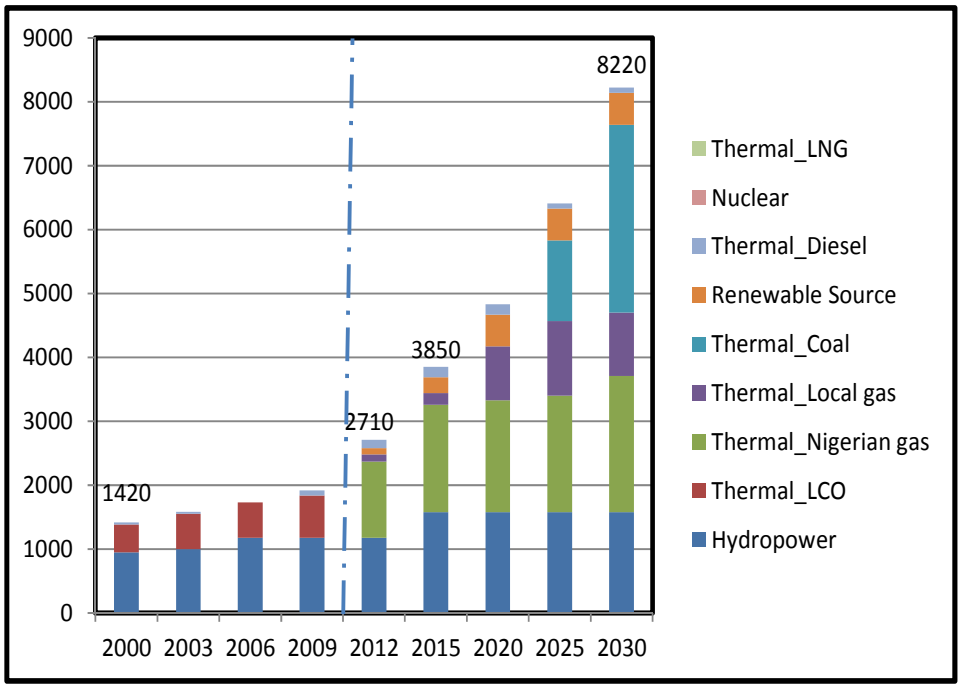

Figure 4.4: Historic and Projected Installed Electricity Generation Capacity Mix (MW)
Source: Ministry of Energy, 2011

The **Energy Sector Strategy and Development Plan** of 2010, which aims at achieving universal access to electricity by extending electricity to all households by 2020, states clearly that Ghana intends to continue with the extension of electricity to towns and rural communities through the National Electrification Scheme up to the year 2020. Rural electrification will be accelerated through the Self-Help Electrification Programme to ensure that 80% access is achieved nationwide by 2015.

In addition, two key programmes were to be implemented from 2011 to intensify electricity supply to households in already electrified communities (Intensification Programme), and develop and use decentralised electricity generation sources for communities remote from the national grid (Decentralised Electricity Programme). With respect to enhancing the productive uses of electricity

(PUE), five pilot projects are expected to be completed in 2013, followed by the development of a comprehensive National PUE Plan in 2014 for implementation to commence by Jan 2015.

The sector strategies outlined in the Development Plan to achieve universal access to electricity are presented in Table 4.2.

4.2.1.1 Gap Analysis

The Ministry of Energy has developed the National Energy Policy, 2010 that provides direction to all energy programmes, including those related to access to electricity. The policy is supported by the Energy Sector Strategy and Development Plan, 2010. The Vision of Ghana's Energy Sector, as presented in the "Energy Sector Strategy & Development Plan, 2010" is "to ensure availability of and universal access to energy services and for export by 2020." The power sector is characterized by a number of strengths which provide opportunities for the realization of the goal of universal access to electricity.

Table 4.2: Strategies to achieve universal access to electricity

Objectives to be achieved	Key Programme and Projects	Possible Financing Sources	Time-frame	Verifiable Indicators/Milestones	Responsible Agency
Achieve universal access by extending electricity to all households by 2020	(i). National Electrification Scheme (Extension of electricity to towns and rural communities)	GoG/Development Partners	1990-2020	• Revised NES Master Plan developed by December 2010 • All communities to be connected to the national electricity grid by 2020	• Ministry of Energy
	(ii) Self Help Electrification Programme (speed up rural electrification through SHEP-Complete SHEP IV and initiate SHEP V, etc)	GoG/Development Partners	2009-2015	• 80% access attained by 2015	• Ministry of Energy
	(iii) Intensification of electricity supply to households in already electrified communities)	GoG/Development Partners/Private sector	2009-2015	• Intensification Programme designed and started by December 2010	• Ministry of Energy
	(iv) Development and use of decentralised electricity generation sources for communities remote from national electricity grid	GoG/Development Partners/Private sector	2009-2015	• Detailed National Decentralised Electricity Programme designed by December 2010	• Ministry of Energy
	(v)Productive Uses of Electricity (PUE) Programme	GoG/Development Partners/Private sector	2009 - 2015	• Five (5) pilot projects completed by 2013 • Comprehensive National PUE Plan completed by Dec 2014 • Commence implementation of PUE Plan by Jan 2015	• Ministry of Energy

Source: Energy Sector Strategy and Development Plan, 2010

The strengths of the power sector include the following:

- A concise national policy framework that articulates clear vision and goals of universal access and sustains commitment of all stakeholders to increased public financing, private sector investment and community participation in the development of the sector.
- Over thirty years of phased and programmed countrywide extension of the national grid, through the National Electrification Programme and Self Help Electrification Project (SHEP); increasing contribution of thermal power to the national power generation mix; and the recent emergence of Independent Power Producers (IPPs). Through SHEP additional local resources have been harnessed communities for electrification. Independent Power Producers are also beginning to emerge in electricity generation.
- Thermal power now plays a more significant role in electricity generation bringing in greater security and diversification. From total dependency on hydro-power in the 1980s, thermal power currently contributes substantially to the generation mix.
- Ghana has begun using gas supplied through the West Africa Gas Pipeline (WAGP) project to power its thermal plants and this is expected to attract new investment in thermal power plants. This will be further enhanced when the proposed development of Ghana's own gas reserves come on stream. Enhanced sub-regional cooperation in energy will open up the sub-regional market for electricity trading
- Improved quality of life through electrification has been further enhanced by making available modern energy devices to remote rural communities.
- Though in its nascent stage, a more consistent, transparent and enabling environment is being developed in Ghana to ensure efficient and optimal operation of the sector and provide legal comfort for private sector investors.

The power sub-sector also faces a number challenges in achieving the stated goal of universal access to electricity. The sector is characterised by inadequate power supply infrastructure requiring huge and enforcement investments; high cost and irregular supply of fuel for electricity generation ; operational inefficiencies in utility companies resulting in transmission and distribution losses for example; weak regulatory and enforcement capacity; vulnerability to climate change especially due to high dependence on hydro vis-a-vis changes in rainfall pattern; and last but not the least, predominance of non-productive uses of electricity.

Ghana has an extensive transmission system which covers all the regions of the country. Transmission infrastructure has, however, deteriorated over the years, resulting in transmission bottlenecks, overloaded transformer sub stations and high system losses.

The electricity distribution infrastructure is extensive providing access to about 72% of the population. However, it is old and obsolete, leading to frequent interruptions in power supply and relatively high system losses. While national access is about 72%, access in the three northern regions is about 30%.

Although increased access to electricity may have contributed to notable welfare improvements in beneficiary communities, especially in terms of enhanced provision of social services such as health, education and water supply, the overall socio-economic development/transformation highly anticipated in these communities has not been realized. This has been largely attributed to the fact that there have not been much productive uses of electricity to generate jobs and incomes for the people, in spite of the fact that ensuring productive uses of electricity was made an integral part of

the NES. Electricity has primarily been used for domestic purposes, mainly for lighting and entertainment.

The key issues and gaps to be addressed under the Ghana's SE4ALL Action Plan are identified and summarised as follows:

- Provision of major incentives for the commercial development of the sub-sector by private sector investment. Increased private sector investment in power generation infrastructure through IPPs will reverse the current situation of the very low proportion of direct investment from the private sector;

- Promotion of productive use of electricity to accelerate agricultural and industrial development; and

- Improve technical, managerial, financial and regulatory capacity of key institutions in order to address inefficiencies, e.g. existing transmission and distribution infrastructure and systems are inefficient resulting in heavy losses

4.2.2 Productive Uses of Electricity

The National Energy Policy of 2010 specifies that productive uses of electricity (PUE) will be promoted as an integral part of the Rural Electrification Programme. The objective of policy measures to increase productive use of energy is to stimulate economic development by ensuring that energy plays a catalytic role in the economic development of the country.

The Energy Sector Strategy and Development Plan of 2010 also indicated that 5 pilot PUE projects would be completed by 2013; a comprehensive National PUE Plan would be completed by December 2014; and implementation of the PUE Plan would commence by Jan 2015.

The Ministry of Energy will be responsible for the PUE Plan and the possible sources of financing are the Government of Ghana, Development Partners and the Private sector. The Ministry has commenced the process in early 2012 by inviting consultants to conduct study on the productive uses of electricity in four selected districts in Ghana.

4.2.2.1 Institutional Framework

The Ministry of Energy (MoEN) will play lead the promotion of productive uses of energy. As the policy oversight body for the sector, the Ministry is expected to work in collaboration with other Ministries and partners including the Energy Commission, the Ministry of Trade and Industry, National Board for Small-scale Industries, Municipal/District Assemblies; Business Associations, NGOs and Community-based Organizations.

The National Board for Small-scale Industries (NBSSI) is the government agency responsible for the promotion and development of the Micro and Small Enterprises (MSE) sector in Ghana. It was established by an Act of the Parliament in 1981, but it however started operations in 1985. NBSSI has its Head Office in Accra, 10 Regional Secretariats and one hundred and ten 110 Business Advisory Centres in the districts. The Ministry of Trade and Industries has oversight responsibility for NBSSI, and is currently implementing a five-year Industrial Sector Support Programme (2010-2015).

The MSME sector which NBSSI is mandated to develop constitutes about 70% of the industrial sector in Ghana and has substantial potential to become the engine of growth of the economy through its contribution to employment generation and poverty reduction.

The objectives of NBSSI in this regard are:-

- To contribute to the creation of an enabling environment for micro and small enterprises development;
- To contribute to the development of an enterprise culture in Ghana;
- To provide non-financial support for sustainable small-scale enterprises development;
- To facilitate access to credit for small enterprises; and
- To strengthen sector associations within the MSE sector.

4.2.2.2 Gap Analysis

The key issues and challenges identified in the promotion of productive uses of energy include the following:

- Development of strategic partnerships with clear roles and responsibilities for key project stakeholders including development partners, Ministries, Departments and Agencies, MMDAs, Community-based organisations, financial institutions, NGOs and private sector entrepreneurs and investors;
- Provision of sound business development training for key project implementers/managers, service providers and beneficiaries of PUE projects.
- Introduction of new business-oriented models and more robust results-based planning, monitoring and evaluation indicators and targets for PUE pilot projects, to ensure long term impact and sustainability of the projects.
- Participation of Municipal and District Assemblies in the monitoring and evaluation of PUE projects, with the assistance of Implementation Committees that will be formed in the various communities where these projects are identified and implemented.
- Improved efficiency in the operation and maintenance of machinery and equipment, and adoption of technological improvements and upgrades.
- Better use and leverage of technical and research institutions such as the GRATIS Foundation, which are widely represented across the lengths and breadth of the country.

4.2.3 Modern Energy for Thermal Application

In terms of ensuring access to clean fuels and devices for cooking and heating, Ghana has adopted a multi-faceted approach with two main pillars, comprising the promotion of the following:

- Liquefied Petroleum Gas
- Improved Cook Stoves

4.2.3.1 Liquefied Petroleum Gas (LPG)

The National Energy Policy of 2010 indicates that the Government intends to increase the use of LPG to 50% of the Ghanaian population by 2015. The Energy Sector Strategy and Development Plan, 2010 indicates that this will be achieved through the development of LPG infrastructure and pricing incentives to encourage distributors to expand their operations to especially the rural and deprived areas.

There are considerable spatial disparities in the access to and use of LPG. In 2011, results of a survey by the Energy Commission on the Energy use in the Residential, Industrial, Commercial and Services Sectors of the Economy, revealed that only about 39.6% of the total number of households surveyed in the country use LPG for cooking. Households in Greater Accra Region have the highest penetration of 63.8% whilst households in Upper West Region have the least penetration of 13.9% (see Table 3.4). In terms of urban and rural households, 50.6% of total

number of urban households surveyed use LPG for cooking whilst only 23.1 % of the total number of rural households depends on LPG. In the urban category, 85.7% of the households found to use LPG for cooking were in the Accra/Tema metropolis compared to 46.3% of households in the other regional capitals. In the rural category, 29.7% of households in rural forest use LPG compared to only 13.0% of households surveyed in rural Savannah.

The main programmes that will be implemented to deliver SE4ALL goals can be summarized as follows:

- Speed up the establishment of a Natural Gas Processing Plant to produce LPG from the associated gas to be produced from the Jubilee Oil and Gas Field. It is estimated that 10,000 barrels (1,340 tonnes) a day of LPG could be produced from the gas from the Jubilee Field;
- Re-capitalise the Ghana Cylinder Manufacturing Company (GCMC) to expand production capacity. The production of cylinders will focus on small sized cylinders that will be affordable to households in rural communities;
- Construct LPG storage and supply infrastructure in all regional and district capitals in the Long term. In the medium term, it is intended to develop district capital LPG infrastructure;
- Increase the LPG distribution margin.

4.2.3.1.1 Relevant Oil and Gas Sub-Sector Institutions

The key institutions which have roles to play in the programmes to increase the access of households and public institutions to LPG are the Ministry of Energy, Energy Commission, National Petroleum Authority, Bulk Oil Storage and Transportation Company, The Ghana National Gas Company Limited, Oil Marketing Companies and LPG Marketing Companies in the Private Sector. The mandates of these organisations are outlined below, with the exception the Ministry of Energy and the Energy Commission which were described in the previous section.

National Petroleum Authority. The National Petroleum Authority (NPA) is a statutory agency regulating, overseeing and monitoring the petroleum downstream industry in Ghana to ensure efficiency, growth and stakeholder satisfaction.

The objects and functions of the NPA include:

- Monitor and regulate petroleum price in accordance with the prescribed pricing formula
- Grant licenses to service providers and marketing companies
- Protect Consumers' interests and maintain the highest standards of petroleum products offered to them.

Bulk Oil Storage and Transportation Company Ltd . The Bulk Oil Storage and Transportation Company Ltd (BOST) was incorporated in 1993 as a private Limited Liability Company with the Government of Ghana as the sole shareholder. BOST has the mandate to develop a network of storage tanks for petroleum products, including LPG, to facilitate distribution throughout the country. BOST has been mandated by the Ministry of Energy to quickly consider the installation of LPG storage to augment the existing private sector facilities. Under the Energy Sector Strategy and Development Plan, 2010, will build three LPG depots at Savelugu (in the North), Kumasi (in the middle belt) and Mami Water (in the east) to supplement the existing LPG storage depot in Tema (in the south) and the proposed BOST depot at Pumpuni (in the west). The three depots are planned to be completed in 2012 and altogether, these depots should alleviate the LPG supply constraints currently facing the country.

Ghana National Gas Company. The Ghana National Gas Company Limited (GNGC) was incorporated as a limited liability company in 2011. The objectives of the GNGC are i) producing natural gas and dry gas for domestic use, power generation and fertilizer production; ii) building up gas infrastructure to enable the monetization of indigenous natural gas reserves; and iii) Facilitating the economic development of Ghana with the availability of reliable gas supplies. The company has the responsibility to build, own and operate infrastructure required for the gathering, processing, transporting and marketing of natural gas resources in the country. In line with its mandate, the GNGC intends to embark on a gas infrastructure development project which involves construction of offshore and onshore pipeline for the transportation of lean gas and natural gas liquids to customers within the western corridor.

Oil Marketing Companies and LPG Marketing Companies. There are currently 56 registered Oil Marketing Companies and 19 registered LPG Marketing Companies in Ghana. The OMCs have formed the Association of Oil Marketing Companies in Ghana, which is a non-profit making organization, formed to promote the interests of its members and bodies engaged as marketers of petroleum products in Ghana, and to provide coordination between the Association and all the major stakeholders in the oil industry, the ministries and other government agencies.

4.2.3.1.2 Strategies and Plans

In 2010, the Energy Commission prepared a draft LPG Promotion Strategy to promote the use of LPG and increase its access to households. Copies of the Strategy document were sent to stakeholders including political parties for their comments. The LPG Promotion Strategy includes the following components: i) expanding domestic LPG supply by upgrading the Tema Oil Refinery; and ii) instituting the Uniform Petroleum Price Fund (UPPF) which fixes margins on many petroleum-derived products, uses gasoline sales to cross-subsidize LPG, and provides financial incentives for LPG sales occurring more than 200 km from the site of the refinery.

The main programmes and projects outlined in the Energy Sector Strategy and Development Plan of 2010 to increase LPG access to 50% of households and public institutions by 2015 are presented in Table 4.3.

4.2.3.1.3 Gap Analysis

Ghana has implemented an LPG promotion programme since 1989. The experiences gained and recent developments of demand outstripping supply provide a strong basis for developing a strategy towards the realization of the dual Government policy objectives of 50% access by 2015 and ensuring supply reliability.

Growing demand and widespread awareness and acceptance of LPG as a clean cooking fuel by the Ghanaian household and commercial sectors is a major strength but there are also considerable challenges. In 2006, an estimated 10% of Ghanaian households used LPG as the main source of fuel for cooking. More recent estimates by the Energy Commission suggest that approximately 40% of household are currently using LPG as the main cooking fuel.

Table 4.3: Strategies to expand availability of LPG to consumers

Objectives to be achieved	Key Programme and Projects	Possible Financing Sources	Time-frame	Verifiable Indicators/Milestones	Responsible Agency
Achieve LPG access to 50% of households and public institutions by 2015	Expansion of capacity for bulk storage of petroleum products including LPG	GoG/BOST/ Private sector	2009-2011	• Completion of Afram Plains Depot, Akosombo, Savelugu under US Exim Bank financing by December 2011 • Project proposals for Takoradi and Wa Depots prepared by December 2009 • Land acquisition for Takoradi and Wa completed by December 2009 Financing arrangements concluded by June 2010 • Takoradi Depot construction commence by June 2011	Bulk Oil Storage and Transport Co.
	National LPG Promotion Programme	GoG/Private sector	2009-2015	• Prepare Medium to Long Term National LPG Promotion Programme by June 2010 • LPG Promotion Fund established by December 2010 • Commence implementation of LPG Programme by May 2011	• Energy Commission • Ministry of Energy
		GoG/Private sector	2010-2012	• GCMC Financial Recovery Plan ready by December 2009 • Commence implementation of GCMC Financial Recovery Plan by January 2010	GCMC

Source: Energy Sector Strategy and Development Plan, 2010

Whilst demand for LPG has grown considerably, averaging over 40% between 2000 and 2010, the existing production infrastructure at Tema Oil Refinery is inadequate. The refinery is the only LPG production facility in the country and has daily production rate of 200-250 tonnes/day. This is a fraction of the daily demand of the country of about 1,000 tonnes. The refinery has a current storage capacity of 6,300 metric tonnes which is insufficient for the growing demand for the product by both commercial and domestic users. The situation has resulted in intermittent but severe shortages of LPG countrywide.

Most second cycle schools, hospitals and prisons which embraced the LPG programme have also gone back to the use of charcoal and firewood for cooking because of supply difficulties. In 2006, the Household Energy Project (sponsored by the UNDP) also supported 22 schools to convert their kitchens to the use of LPG. After 6 months of use, the schools abandoned LPG because they found LPG more expensive than firewood.

The situation is further complicated by the increasing number of commercial vehicles patronizing LPG as against transport fuels as a cost-saving measure. The transport sector accounts for about 37% of the country's weekly consumption of LPG currently estimated at 4,000 tonnes. Commercial vehicle drivers have found LPG cheaper than other transport fuels due to higher price differential between LPG and gasoline. This price differential is mainly as a result of the subsidy component on LPG in the price build-up, which was designed for domestic users with the primary objective of helping households to meet their demand at an affordable price.

The government currently spends about GH¢14 million subsidizing LPG every month and there are strong indications within government circles that there are plans to review LPG subsidy scheme because it is not benefiting only the intended beneficiaries, as well as the fact that the scheme was becoming unsustainable. In 1994, the Road Traffic (use of Liquefied Petroleum Gas) Regulations, 1994, LI 1592 was passed to regulate the use of LPG as fuel in vehicles. The enforcement of LI 1592 has been ineffective leading to the blatant abuse of the LPG subsidy by commercial vehicles.

In summary, the main challenges to be addressed in the sector include inadequate infrastructure in the entire LGP value-chain; inadequate supply of LPG to meet the increasing demand of LPG and increased use by motorists; outmoded, inefficient and inequitable modalities for delivery of LPG to consumers; and inefficient LPG cylinder management

The LPG Retail Model which at the moment has 320 small refilling plants of 10-20 tonnes is outmoded because they are located mainly in high density population centres; 60% of district capitals have no stations; transaction cost is high; and there are serious safety concerns on quality of LPG cylinders.

In respect of LPG cylinder management, which is a key component of the LPG infrastructure, the issues to be addressed include Supply and handling of LPG cylinders; Distribution of the cylinders in remote rural communities; Responsibility for care of LPG cylinders - recertification, repairing, withdrawal; and Institutional capacity building to ensure the efficient supply and distribution of LPG.

The key issues and gaps to be addressed under the Ghana's SE4ALL Action Plan relating to access to clean energy are identified and summarised as follows:

- Uncertainty concerning the attainment of 50% access to LPG by 2015 if the fuel is to be rendered less affordable by the removal of the subsidy on LPG;
- The challenge concerning the use of LPG as automobile fuel; and
- Development of other policy measures (apart from pricing of the fuel) that can be introduced to help promote the use of LPG.

- Some stakeholders have made the following recommendations to address these issues:
- Need to introduce a more effective Business Model for managing LPG cylinder supply chain in order to make full cylinders available within 5 minutes' walk from households, especially in petrol filling stations and general goods retail shops.
- Need to develop a new business model to facilitate rapid household/commercial access to LPG as a fuel for cooking.
- Ensuring adequate investment in the cylinders, build up the distribution network and retail outlets, modern high speed quality controlled plant, hydro testing and recertification of cylinders and withdrawal, or repair cylinders.
- Need for the development of networks of gas shops/outlets, the review UPPF modalities, and the promotion of social marketing
- Reform of LPG for cooking subsidy policy to make it sustainable and equitable, and possible replacement of subsidy on the LPG fuel with subsidy on cylinders /accessories to check abuse of the subsidy policy.

4.2.3.2 Improved Cook Stoves

Fuel wood and charcoal meet approximately 75% of Ghana's fuel requirements. Approximately 69% of all urban households in Ghana use charcoal. The annual per capita consumption is approximately 180 kg; the total annual consumption is about 700,000 tonnes. Accra and Kumasi, the two largest cities in Ghana, account for 57% of all charcoal consumed in the country.

The main thrust of Government policy on wood fuels, as contained in the National Energy Policy, 2010 is to sustain the supply and efficient use of wood fuels while ensuring that their exploitation does not lead to deforestation. The related policy for pricing wood fuels focuses on: i) Prices based on market forces; and ii) Taxes and levies on wood fuels being regulated by the appropriate national agencies or local authorities, as may be necessary.

The focus of the biomass strategy, as indicated in the Energy Sector Strategy and Development Plan, 2010 is the (i) regeneration of forest cover through afforestation; and (ii) improvement in the production and efficient use of wood fuels. In the long term, the focus is on fuel substitution to alternative sources of energy.

In addressing the challenges relating to wood fuels, the strategies implemented by Government will include:

- Support for the sustained regeneration of woody biomass resources through legislation and fiscal incentive;
- Promotion of the establishment of dedicated woodlots for wood fuel production;
- Promotion of the production and use of improved and more efficient wood fuel utilisation
- technologies;
- Promotion of the use of alternative fuels such as LPG as substitute for fuel wood and charcoal; and
- Promotion of the production and use of other wood fuel energy resources (waste, biofuels).

The Renewable Energy Bill which has been passed by Parliament and awaiting Presidential assent also states that the policy direction on biomass is to support sustained regeneration of woody biomass resources through legislation, fiscal incentives and attractive pricing and promote the establishment of dedicated woodlots for woodfuel production. The Bill re-emphasizes that Government seeks to promote the production and use of improved and more efficient biomass utilisation technologies. Government also intends to promote the use of alternative fuels, like liquid petroleum gas as a substitute for fuel, wood and charcoal by addressing the institutional and

market constraints that hamper increasing access to it in Ghana. The policy direction for pricing wood fuels focuses on prices based on market forces and the regulation of taxes and levies on woodfuels by the appropriate national agencies or local authorities where necessary.

4.2.3.1.1 Institutional Framework

The Ministry of Energy (MoEN) continues to play a key role in the promotion of improved stoves, in collaboration with the following institutions and agencies:

- Academic Institutions, Regional Technology Tranfer Centres and the Institute of Industrial Research, of the Centre for Scientific and Industrial Research (CSIR):
- MoEN collaborates with the universities, polytechnics and the Institute of Industrial Research, as well as the Regional Technology Transfer Centers (RTTCs) of the GRATIS Foundation to train local artisans in the fabrication of improved fuelwood and charcoal cookstoves
- MDAs, CBOs and NGOs
- The Municipal/District Assemblies (MDAs), Community-based Organizations (CBOs) and Non-Governmental Organisations (NGOs) are expected to use their grassroots administrative systems and structures to assist in the public awareness and education campaigns of the project.

4.2.3.1.2 Gap Analysis

Improved cookstoves are now more available commercially in Ghana, with the setting up of private sector cookstove manufacturing firms such as Toyola Energy Limited. In addition, significant experience has been accumulated in developing and implementing small-scale and disaggregated financing programs.

Furthermore, new financing instruments and sources, especially those linked to climate-change mitigation, are available. The Global Environment Facility, Carbon Funds, and Climate Investment Funds offer potential opportunities for financing.

Coalitions supporting improved cookstoves and clean cooking are also being formed, as a result of a resurgence of interest in household energy use. One of such alliance that has been recently formed is the Global Alliance for Clean Cookstoves (GACC), led by the United Nations Foundation (World Bank, 2011).

In terms of the SE4ALL, the strength of improved cookstoves in achieving social, economic and environmental goals can be summarized as follows:

Social:

- Reduced fuel costs for families and freeing up money for other uses, thereby improving livelihoods of the poor.
- The improved stoves provide less smoky, reduced emissions of hazardous air pollutants and improved the health of users, typically women and children.

Economic:

- Employment and income opportunities throughout the value chain i.e. in manufacturing, distribution, retailing, quality control and project management.
- Improving technological self-reliance when stoves are locally manufactured and specialist skills developed or transferred in-country.

Environmental:

- Significant savings in greenhouse gas emissions through a reduction in charcoal consumption.
- Reduced pressure on remaining forest reserves in Ghana, slowing widespread deforestation and aiding biodiversity.

Many of the programmes to promote improved cookstoves under-performed mainly due to the following reasons: lack of standards and quality control of the cookstoves; high cost of the improved cookstoves compared to the traditional cookstoves; and supply driven projects that paid very little attention to consumer research, stove design, market development, long-term financing and business growth.

In order to scale up the adoption of improved cookstoves nationwide requires the implementation of sustainable promotional measures that:

- Promote technical research and development to adapting cookstoves and programs to country context;
- Develop performance standards and benchmarks on safety, (energy) efficiency, emissions, and durability;
- Promote awareness raising, consumer research and business development taking account of consumer preferences and behaviour;
- Develop innovative financing mechanisms that can target subsidies and grants;
- Enhance the capacity of local and national institutions to promote advanced biomass cookstoves;
- Encourage the establishment of energy funds that enable financial institutions to effectively administer support to promote biomass cookstoves; and
- Develop and implement coordination, monitoring and evaluation (M&E) mechanisms.

4.2.4 Promotion of Energy Efficiency

The losses in the production, transmission and use of energy in Ghana are quite high. System losses in electricity distribution are about 25%, with wastage in the end-use of electricity also estimated at about 30%. Reduction of losses in energy supply and more efficient use of energy would contribute to reduction in the demand for energy.

Energy efficiency and conservation measures can also mitigate high growth rates in energy demand and reduce wasteful consumption. According to the Energy Commission, electricity demand is growing between 6% and 7% annually while consumption of petroleum products is estimated to increase at about 5% per annum. On the other hand, the annual growth in the demand for fuelwood and charcoal is estimated at 3% per annum.

One of the strategic goals of National Energy Policy of 2010 is to ensure end-use efficiency and conservation of energy through the following policy prescriptions:

- An appropriate pricing regime for energy services established to provide incentives to domestic and industrial consumers to voluntarily manage their energy consumption;
- Programmes and measures developed and implemented to assist consumers optimise their energy use;
- Implementation of austained and comprehensive public education and awareness creation campaign on the methods and benefits of energy conservation supported;
- Establishment of a Centre for Energy Efficiency promoted; and

- Local production, importation and use of high energy consuming vehicles and inefficient electricity consuming equipment and appliances discontinued, through legislation.

Legislative Instruments to promote improvements in energy efficiency developed by the Energy Commission that have been passed by Parliament include:

- Energy Efficiency Standards and Labeling (non-ducted air conditioners and self-ballasted fluorescent lamps) regulations, 2005, LI-1815
- Energy Efficiency (Prohibition of manufacture, sale or importation of incandescent filament lamp and used air-conditioner) Regulations, 2008, LI 1932
- Energy Efficiency Standards and Labeling (refrigerators and freezers) Regulations, 2010 L.I. 1958 & 1970

End-use electrical wastage is being reduced by implementation of Demand-Side Management measures that:

- ensure efficiency in energy use in all sectors of the economy;
- improve productivity of industries through the use of efficient technologies;
- improve system reliability by reducing demand; and
- reduce and manage power system demand through load shifting

Under the Energy Sector Strategy and Development Plan, 2010 the strategies to reduce wastage and ensure the more efficient use of electricity are summarized in Table 4.4.

4.2.4.1 Institutional Framework

The key players in energy efficiency sub-sector in Ghana are the Energy Foundation, Energy Commission, Ghana Standards Authority and private sector/civil society organizations such as the Association of Ghana Industries, Private Enterprise Foundation, Ghana National Chamber of Commerce and Industry, Chamber of Mines, and the Ghana Employers Association.

Table 4.4: Strategies to reduce wastage and ensure more efficient use of electricity

Objectives to be achieved	Key Programme and projects	Possible Financing Sources	Time-frame	Verifiable Indicators/Milestones	Responsible Agency
Achieve 10% savings in electricity consumption through electric power efficiency and conservation measures.	(i) Power Factor Correction Programme in Public Institutions, Commercial and Industrial Entities	GoG (Electricity Demand Management Fund)/Private sector	2009-2012	• Equipment installed in first 25 Public institutions by Dec 2010 • Equipment installed in all 100 public and commercial and industrial businesses by 2012	• Energy Commission
	(ii) Public Awareness Campaign Programme on Energy Efficiency and Conservation	GoG/ECG/VRA/Independent Power Producers	2009-2012	• Public Awareness Programme submitted and approved by EC by March 2010 • Commence implementation by April 2010	• Energy Commission/ Energy Foundation
	(iii) Implementation of Legislation on Ban of Importation and Use of Inefficient Electrical Appliances	Energy Fund	2009-2012	• Importation of inefficient electrical appliances eliminated by Dec 2010 to December 2012	• Energy Commission/ Ministry of Energy/CEPS/GSB

4.2.4.2 Gap Analysis

The main strengths related to the promotion of energy efficiency are the existence of newly enacted and updated laws to regulate end-use efficiency and conservation and high level of awareness by Government and key stakeholders of the need for end-use energy efficiency and conservation following the energy crisis in 2007 and increasing cost of energy. On the other hand, the challenges related to the promotion of energy efficiency are significant. They include:

- Weak public education and awareness of significance and measures for energy efficiency and conservation;
- Lack of fiscal and financial incentives to encourage the use of energy efficient appliances and technology;
- Inadequate financing for energy efficiency and conservation programmes;
- Limited outreach of relevant institutions to extend services to districts and rural communities;
- Weak institutional capacity for monitoring and enforcement of relevant regulations; and
- Weak coordination of monitoring and enforcement of relevant regulations

In terms of the SE4ALL, the key issues to be addressed to promote of energy efficiency in Ghana include:

- Intensive and extensive public awareness and education;
- Improved institutional capacity building and effective coordination for monitoring and enforcement of relevant regulations;
- Fiscal and financial incentives to encourage the use of energy efficient appliances and technology by households, commercial and industrial sectors;
- Innovative financing schemes for energy efficiency and conservation programmes; and
- Addressing gaps in statistical data for periodically evaluating the rates of energy efficiency and conservation nationwide, covering domestic, industrial, commercial and agricultural users and public services (e.g. health and education).

4.2.5 Share of Renewable Energy in the National Energy Mix

The overall policy objective for the Renewable Energy sub-sector is to increase renewable energy supply in the total national energy mix to 10% by 2020 and ensure its efficient production and use. Ghana's Parliament has passed the Renewable Bill 2011, awaiting Presidential assent into law. The Bill creates a favourable regulatory and fiscal regimes as well as attractive pricing incentives for the development and use of its renewable energy resources. Its provisions support the development, utilization and efficient management of renewable energy sources in the country. It also provides for the utilization, sustainability and adequate supply of renewable energy for electricity and heat generation and related matters. One of its aims is to increase the proportion of renewable energy, particularly solar, wind, mini hydro and waste-to-energy in the national energy supply mix while contributing to the mitigation of climate change.

The respective measures in Ghana's renewable energy strategy for wood fuels, liquid biomass, solar, wind and mini hydro development include the following:

Wood fuels:

- Support sustained regeneration of woody biomass resources through legislation and fiscal incentive;
- Promote the establishment of dedicated woodlots for wood fuel production;

- Promote the production and use of improved and more efficient woodfuel utilization technologies;
- Promote the use of alternative fuels such as LPG as substitute for fuel wood and charcoal; and
- Promote the production and use of other woodfuel energy resources (waste, biofuels).

Liquid Biomass Fuels:

- Balance biofuel development against food security;
- Support development of biofuels as a transportation fuel as well as a job creation initiative; and
- Support private sector investments in cultivation of biofuel feedstock, extraction of the bio-oil and refining of bio-oil into secondary products by creating appropriate financial and tax incentives.

Solar, Wind and Mini Hydro:

- Promote the exploitation and use of mini hydro, solar and wind energy resources;
- Support indigenous research and development aimed at reducing the cost of renewable energy technologies;
- Provide tax incentives for the importation of all equipment used in the development of renewable and waste energy projects; and
- Support the use of decentralized off-grid alternative technologies (such as solar PV and wind) where they are competitive.

Waste-to-Energy:

- Convert most of the wastes generated in municipal activities, industrial operations and agricultural operations to energy, as a means of managing the growing sanitation problems and contributing to energy supply and security;
- Maximise energy production from waste;
- Divert waste from landfills (prohibit burying of waste and landfills);
- Facilitate access to grid for waste to energy power plants; and
- Develop infrastructure for waste collection and supply to waste-to-energy facilities

Under the Energy Sector Strategy and Development Plan, 2010 most of the renewable energy strategies are summarized in Table 4.5. The strategies related to waste-to-energy are summarized in Table 4.6.

4.3.5.1 Institutional Framework

The key players in renewable energy sub-sector in Ghana are the Ministry of Energy, Energy Commission, Energy Foundation and private sector/civil society organizations such as the Association of Ghana Industries, Private Enterprise Foundation, Ghana National Chamber of Commerce and Industry, Chamber of Mines, and the Ghana Employers Association.

Table 4.5: Strategies to increase renewable energy in national energy supply mix

Objectives to be achieved	Key Programme and Projects	Possible Financing Sources	Time-frame	Verifiable Indicators/Milestones	Responsible Agency
Increase the renewable energy supply in national energy mix to 10% by 2020	(i) Grid-connected Solar PV programme for public institutions	ECOWAS Bank for Investment and Development (EBID)	2009-2013	• Finalise proposals with ECOWAS Bank by December 2009	• Ministry of Energy
	(ii) Grid-connected solar PV in estate development	ECOWAS Bank for Investment and Development (EBID)	2009-2013	• Finalise proposals with ECOWAS Bank by December 2009	• Ministry of Energy
	(iii) Wind Farm Project (50 MW at Kpone) Development of wind power projects a). Wind farm project b). 3 Wind Mast	Private sector financing/GOG	2009-2014	• Finalise PPA for project by December 2009 • Commence construction by June 2011 • 3 wind mast installed and monitored by 2013 • 50 MW Wind Project ready by December 2014	• Energy Commission/Ministry of Energy
	(iv) Development of Mini Hydro Demonstration Project	GoG/Development Partners/Concessionary funding	2009-2013	• Prepare detailed Feasibility Studies on 21 mini hydro sites completed by 2010 • Establishment of MOU with KNUST by June 2010	• Ministry of Energy
	(v) Bio-fuels Projects	Private sector financing	2009-2010	• Complete Renewable Energy Law (Biofuels) by June 2010 • Complete Biofuels Regulations by August 2010	• Energy Commission
Develop legislation to encourage renewable energy technology development and utilisation	Development of Renewable Energy Law	GoG/Development Partners	2009 - 2010	• Renewable Energy Law passed by June 2010.	• Energy Commission

Table 4.6: Strategies to convert wastes to energy

Objectives to be achieved	Key Programme and Projects	Possible Financing Sources	Time-frame	Verifiable Indicators/Milestones	Responsible Agency
Management of municipal, industrial, and agricultural wastes through energy production.	(i)Metropolitan waste-to-power project	GoG/Private sector/DPs	2010-2015	Framework for Metropolitan waste-to-power project ready by January 2011	MoEn/EC
	(ii)Institutional biogas project (Universities, Polytechnics and Senior High Schools)	GoG/Private	2010-2015	Framework for Institutional biogas project ready by January 2011	MoEn/MoE/Private sector
	(iii)Combined heat and power system for industries	GoG/Private sector	2010-2015	Framework for combined heat and power systems ready by January 2011	MoEn/MoTI/Private sector

4.2.5.2 Gap Analysis

The main strengths related to the promotion of renewable energy in the national energy mix are summarized as follows:

Biomass:

- Widespread availability of biomass resources

Mini-hydro, Solar and Wind energy:

- Favourable locations for mini-hydro development identified
- Favourable wind speed in coastal areas
- Solar radiation levels generally satisfactory

Waste-to-Energy

- Widespread availability and generation of municipal, industrial and agricultural waste

Despite these strengths and opportunities, many rural communities still regard renewable energy (RE) an inferior forms of energy and therefore integration into the NES will require extensive rebranding, strategizing and planning to ensure effective integration of RE into Ghana's energy mix.
Other challenges specific to the various forms of renewable energy include:

Biomass

- Unsustainable production techniques
- Inefficient utilization
- Difficulties in obtaining secure tenure for large tracts of land for commercial development of biomass

Mini-hydro, Solar and Wind energy

- High cost of energy generation due to current state of technology
- Mini-hydro highly susceptible to climate changes

Waste-to-Energy

- Low exploitation of waste-to-energy technologies
- High cost associated with the collection and management of waste materials.

The under listed are key issues and gaps related to the promotion of renewable energy in the national energy mix:

- Availability of land with secure tenure for private sector investment in large-scale biomass development;
- Long-term sustainability of biomass production;
- High initial investment cost of energy generation from solar, wind and mini-hydro;
- High cost of waste collection and management; and

- Inadequate statistics and data disaggregation on renewable energy.

4.3 PROGRAMS AND FINANCING

4.3.1 Power Sector: Programs to Improve Access, Efficiency and Use of RES for Power Supply

4.3.1.1 National Electrification Scheme (NES)

The Government of Ghana initiated the National Electrification Scheme (NES) in 1989 as its principal policy to extend the reach of reliable electricity supply to all parts of the country over a 30-year period from 1990 to 2020. The objectives of the NES were as follows:

- Increasing the overall socio-economic development of the nation and creating wealth thereby alleviating poverty, especially in the rural areas.
- Increasing people's standard of living, especially those in the rural areas.
- Creating small-to-medium scale industries in rural areas.
- Enhancing activities in other sectors of the economy, such as agriculture, health, education, tourism etc.
- Creating jobs in the rural areas and thereby reducing the rate of rural to urban migration.

4.3.1.2 Self-Help Electrification Project (SHEP)

The SHEP is a complementary electrification programme instituted to support the main National Electrification Scheme (NES) with the rationale of accelerating the connection of communities to the national electricity grid. The intent is to encourage the self-help developmental initiatives of both rural and urban communities in Ghana. SHEP has been implemented in phases. Phases 1 and 2 were initiated from 1989-1992 and 1992-1996, respectively while phases 3 and 4 were implemented between 1996-2005 and 2005-2008, respectively (Ministry of Energy, 2009). Under the SHEP, communities that are within 20 km from an existing 33 kV or 11 kV sub-transmission line can bring forward their electrification projects provided they procure all the poles required for the LV network and have a minimum of 30% of the houses within the community wired. Once these conditions are met by the community, the obligation of the government is to provide the conductors, pole-top arrangements, transformers and other installation costs needed to provide supply to the community.

4.3.1.3 Ghana Energy Development And Access Project (GEDAP)

The Ghana Energy Development and Access Project (GEDAP), is multi-donor funded project involving the International Development Agency (IDA), Global Environment Facility (GEF), African Development Bank (AfDB), Global Partnership on Output-based Aid (GPOBA), Africa Catalytic Growth Fund (ACGF) and the Swiss Agency for Economic Affairs (SECO).

The development objective of the Ghana Energy Development and Access Project is to improve the operational efficiency of the electricity distribution system and increase the population's access to electricity using multiple electrification and service delivery schemes.

The global environmental objective of the project is to support Ghana's transition to a low carbon economy through the reduction of greenhouse gas emissions (GHG).The project will assist this transition through the development of renewable energy for the expansion of access to electricity, where economically justified. Furthermore, improvements in the operational efficiency of the distribution system are likely to generate additional GHG reductions subject to carbon financing.

The main indicator for meeting the project's global environmental objective will be tonnes of carbon dioxide (CO2) emissions avoided, calculated over the estimated lifetime of renewable energy equipment that the project will install.

GEDAP comprises four principal components as follows:

- Component A : Sector & Institutional Development
- Component B : Distribution System Improvement
- Component C : Electricity Access Expansion and Renewable Energy Development
- Component D: Transmission System Upgrade

Sector & Institutional Development

The component for sector and institutional development is broad-based and critical to meeting the project's development objectives for increased efficiency of power supply and expanded access to electricity. Beneficiary agencies: Ministry of Energy, Electricity Company of Ghana, Volta River Authority(Northern Electricity Department), ARB Apex Bank, Public Utility Regulatory Commission, Environmental Protection Agency.

Distribution system improvement

This component is intended to support investments in infrastructure to improve system reliability and reduce losses. An ancillary impact of the investments will be the removal of supply bottlenecks in sections of the distribution network.

Electricity Access Expansion and Renewable Energy Development

This component is intended to support a new and multifaceted approach to expanding electricity access in Ghana tailored to geographical location, potential level of electricity demand, and distance from the existing grid. In this context, the component will provide financing for investments, technical assistance and training in support of: intensifying the use of the existing ECG and NED distribution networks (75,000 connections); extending these networks where economically viable (64,000 connections); developing new, isolated mini-grids serving towns and clusters of consumers far from existing networks (20,000 connections); and providing solar photovoltaic (PV) systems for lighting in remote rural areas (10,000 households). To stimulate the market for off-grid systems, the project also will introduce new financing systems and institutions to encourage the development of small, private energy businesses and make electricity access more affordable to consumers.

The project will set up new institutional and financial mechanisms for the extension of the network in areas where economically viable; the development of mini grids using renewable energy for population clusters far from the grid where grid connection would be less efficient and more costly; and the establishment of a program for disseminating solar systems in remote, sparsely populated rural areas that can only afford electricity for lighting. For the extension of the grid and the development of mini grids, the project will create the Rural Electrification Agency (REA), which also will manage a Rural Electrification Fund (REF) to help finance these activities. The project also will establish an innovative business model for the distribution of solar PV home systems for lighting, in which dealers will provide a combination of equipment and service packages through a system of output based bonuses and rural consumers will have access to credits through rural banks at terms that will make these systems affordable.

Transmission System Upgrade

This component is intended to support investments in transmission and distribution infrastructure upgrade to improve reliability and reduce the risk of major outages in the city of Kumasi.

4.3.4.1 Financing

The NES/ SHEP Projects are financed through a mixture of Local and External Sources:

External Sources:

- Grants and soft loans from a consortium of financing institutions including the Multilaterals & Bilateral funding agencies;
- Suppliers Credit

Local sources:

- GoG -Consolidated fund, levy on consumers, Utilities/ Agencies
- Local Government –MP's Common Fund, District Assemblies
- Community-provision of woodpoles and labour

Currently, there are a number of Funds into which levies on energy consumption are paid to finance specific development activities in the power sector. The levies include: (i) Rural Electrification Levy which is paid into the National Electrification Fund, (ii) Street Lighting Levy, and (iii) the Power Factor Surcharge Levy which is paid into the Electricity Demand Management Fund.

In addition, Government intends to pursue a number of options for securing increased private sector participation and financing, including support for Power Purchase Agreements (PPAs) between distribution utility companies and prospective Independent Power Producers (IPPs), providing an enabling legal, institutional and regulatory framework. For example, the Energy Commission Act 541 provides for a number of regulations that are intended to support private sector participation in the power sector.

4.3.2 Ghana Climate Change Programme

With an emphasis on adaptation, this proposed programme is intended to provide Ghana with the building blocks and systems for a long-term strategic approach to climate change (including adaptation and disaster risk reduction, low carbon development and forestry). As such, it meets the purpose of the ICF to "support international poverty reduction by helping developing countries to adapt to climate change, take up low carbon growth, and tackle deforestation." It supports delivery of the DFID Business Plan objective on climate change and the DFID response to the Humanitarian and Emergency Response Review , including its commitments to "Improve our use of science in both predicting and preparing for disasters … to inform and prioritise country and regional level work on resilience…" and to "Integrate resilience and disaster risk reduction into our work on climate change." A bid for a Ghana climate change pillar under the Bilateral Aid Review was well reviewed but deferred pending the launch of the ICF.

DFID climate support to Ghana has a wider demonstration value. By systematically applying knowledge, this programme will deepen the evidence base for targeted responses by Government and other partners in Ghana and tackle the vulnerability central to DFID Ghana's Operational Plan. By building absorptive capacity and delivery systems, as well as leveraging efforts by other development partners, this support will ensure greater effectiveness and value for money. It will also consolidate the relationship with a respected member of the African Group with considerable

behind-the-scenes influencing activity, moderate institutional capacity and a growth path that other countries are likely to pursue.

4.3.2.1 Financing

The program has a three year duration and it is financed by the Department for International Development (DfID) of the United Kingdom with a budget of £14 million. The funding will cover: a programme-funded climate adviser to support the national climate change committee and oversee coordination and delivery; more resourcing to target risk assessments, to interpret the technical climate observation and flood early warning system to ensure their application, and to leverage UK experience on resilience; more effort to leverage private sector investments on climate technology innovation, value chains and dry woodlands in the north. These elements complement other DFID Ghana programming and provide the climate expertise and enabling environment for delivery, particularly for the north.

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