Republic of Ghana

Ghana

Sustainable Energy For All Action Plan

June, 2012

FORWARD

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	ix
1.0 INTRODUCTION	1
1.1 BACKGROUND	1
1.2 GHANA'S DEVELOPMENT POLICY	2
1.3 SEAAF CONCEPTUAL FRAMEWORK AND CAP METHODOLOGY	3
1.4 SEAAF OBJECTIVES	4
1.5 METHODOLOGY USED IN PREPARING THE SE4ALL COUNTRY ACTION PLAN	5
1.5.1 SEAAF Consultative Process	5
1.6 COUNTRY OVERVIEW	5
2. PROGRESS AND CHALLENGES IN ACHIEVING SUSTAINABLE ENERGY FOR ALL (SE4ALL)	10
2.1. OVERVIEW OF GHANA'S ENERGY SECTOR	10
2.1.1 Electricity	10
2.1.2 Petroleum Fuels	13
2.1.3 Woodfuels	14
2.2. OVERALL ASSESSMENT OF PROGRESS TOWARDS SUSTAINABLE ENERGY FOR ALL	16
2.2.1. ENERGY ACCESS vis-à-vis GOAL OF SE4ALL	16
2.2.1.1 Universal Access to Electricity	16
2.2.1.2 Modern Energy for Cooking	17
2.2.1.2.1 Promotion of LPG	17
2.2.1.2.2 Promotion of on Improved Cookstoves	19
2.2.1.3 Modern Energy for Productive Uses	22
2.2.2 Energy Efficiency vis-à-vis Goal of SE4ALL	23
2.2.2.1 Promotion of Compact Fluorescent Lamps	23
2.2.2.2 Power Factor Improvement	24
2.2.3 Renewable Energy vis-à-vis Goal of SE4ALL	24
2.2.3.1 Biomass	24
2.2.3.2 Solar Energy	25
2.2.3.3 Wind Energy	26
2.2.3.4 Mini-Hydro	28
2.2.3.5 Agro-Waste	28
2.2.3.6 Municipal Waste	29
3. STRATEGIC INTERVENTIONS	30

3.1 STRATEGIC INTERVENTIONS OF HIGH IMPACT FOR THE ACHIEVEMENT OF SE4ALL GOALS 30
3.1.1. Universal Access to Energy 30
3.1.1.1 Electricity to Communities and Households 30
3.1.1.1.1 National Electrification Scheme (NES) 30
3.1.1.1.2 Self-Help Electrification Project (SHEP) 31
3.1.1.1.3 Ghana Energy Development and Access Project (GEDAP) 31
3.1.1.2 Mechanical Power for Productive Uses 32
3.1.1.3 Modern Energy for Cooking 33
3.1.1.3.1 Liquefied Petroleum Gas (LPG) Promotion Strategy 34
3.1.1.3.2 Improved Cook Stoves 37
3.1.2. Doubling the Share of Renewable Energy in the Global Energy Mix 38
3.1.3. Doubling Improvements in Energy Efficiency 40
3.1.4 Cross-Cutting Issues 40
4. BOTTLENECK ANALYSIS 41
4.1 BOTTLENECKS ON PROMOTION OF PUE 42
4.2 BOTTLENECKS ON PROMOTION OF MODERN ENERGY FOR COOKING 43
4.2.1 LPG Promotion Bottlenecks 43
4.2.2 Improved Cookstoves Promotion Bottlenecks 44
5. ACCELERATING SE4ALL PROGRESS – IDENTIFYING SOLUTIONS 48
6. SE4ALL ACCELERATION PLAN – GHANA COUNTRY ACTION PLAN 55
7. IMPLEMENTATION ARRANGEMENTS OF SE4ALL COUNTRY ACTION PLAN 66
7.1 ANNUAL NATIONAL SE4ALL FORUM 66
7.2 INTER-MINISTERIAL COMMITTEE 66
7.3 THE SECRETARIAT 67
REFERENCES 69

LIST OF TABLES

Page

TABLE 2.1: GENERATION CAPACITY (END OF DECEMBER 2010) 10
TABLE 2.2: ELECTRICITY GENERATION BY PLANT (GWH) 11
TABLE 2.3: CONSUMPTION OF LPG COMPARED TO OTHER PETROLEUM PRODUCTS 13
13
TABLE 2.4: BIOMASS-FIRED CO-GENERATION PLANTS IN GHANA 25
TABLE 2.5: SOLAR PV INSTALLATIONS IN GHANA 26
TABLE 4.1: SUMMARY OF BOTTLENECKS TO KEY PRIORITY INTERVENTIONS ON PRODUCTIVE USE OF ENERGY / MODERN ENERGY FOR COOKING TO ACHIEVE SE4ALL 46
TABLE 5.1: PRIORITIZED SOLUTIONS FOR ACCELERATING PROGRESS TOWARDS SUSTAINABLE ENERGY FOR ALL IN GHANA 49
TABLE 6.1: COUNTRY ACTION PLAN TOWARDS SUSTAINABLE ENERGY FOR ALL IN GHANA 56
TABLE 6.2: GHANA CAP IMPLEMENTATION AND MONITORING PLAN 63

TABLE OF FIGURES

Page

FIGURE 1.1: RELATIONSHIP BETWEEN SUSTAINABLE ENERGY SERVICES AND 5 KEY MDGS ERROR! BOOKMARK NOT DEFINED.

FIGURE 1.1: MAP OF GHANA SHOWING THE TEN REGIONS AND THEIR CAPITALS 6

FIGURE 2.1: WOODFUEL BALANCE OF GHANA (2000-2020) 15

FIGURE 2.2: COMMUNITIES WITH ELECTRICITY CONNECTION 16

FIGURE 2.3: LOCATION OF LPG RETAIL STATIONS ACROSS GHANA 18

FIGURE 2.4: CSIR-IIR IMPROVED FIREWOOD STOVE 20

FIGURE 2.5: TOYOLA IMPROVED FIREWOOD STOVE 20

FIGURE 2.6: TRADITIONAL CHARCOAL 20

FIGURE 2.7: AHIBENSO IMPROVED STOVE 20

FIGURE 2.9: A RETAIL SHOP DISPLAYING TRADITIONAL AND IMPROVED STOVES 21

FIGURE 2.10: SOLAR RESOURCE POTENTIAL OF GHANA 26

FIGURE 2.11: WIND RESOURCE POTENTIAL OF GHANA 27

FIGURE 2.12: HYDROPOWER SITES IN GHANA 28

FIGURE 3.1: REVISED PROJECTION OF LPG ACCESS IN GHANA 35

LIST OF ABBREVIATIONS

ACGF	Africa Catalytic Growth Fund
AfDB	African Development Bank
BST	Bulk Supply Tariff
CAP	Country Action Plan
CBOs	Community-based Organizations
CEPA	Centre for Economic Policy Analysis
CSIR	Council for Scientific and Industrial Research
CSOs	Civil Society Organizations
CWSA	Community Water and Sanitation
DAs	District Assemblies
DPs	Development Partners
DSC	Distribution Service Charge
EC	Energy Commission
ECG	Electricity Company of Ghana
EPA	Environmental Protection Agency
EUT	End User Tariff
FAO	Food and Agriculture Organization
FC	Fisheries Commission
FDI	Foreign Direct Investment
GACC	Global Alliance for Clean Cookstoves
GCMC	Ghana Cylinder Manufacturing Company
GDP	Gross Domestic Product
GEDAP	Ghana Energy Development and Access Project
GEF	Global Environment Facility
GGC	Ghana Gas Company
GHG	Green House Gases
GIDA	Ghana Irrigation Development Authority
GIFA	Ghana Inland Fishermen Association
GPOBA	Global Partnership on Output-based Aid

GPRS	Ghana Poverty Reduction Strategy
GRIDCO	Grid Development Company
GSA	Ghana Standards Authority
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statistical Service
HDI	Human Development Index
HDR	Human Development Report
ICS	Improved Cook Stoves
IEA	International Energy Agency
LPG	Liquefied Petroleum Gas
MAAF	MDG Acceleration Framework
MDGs	Millennium Development Goals
MEST	Ministry of Environment, Science and Technology
MMDAs	Metropolitan, Municipal and District Assemblies
MOE	Ministry of Education
MOEn	Ministry of Energy
MOFA	Ministry of Food and Agriculture
MOH	Ministry of Health
MOI	Ministry of Information
MOTI	Ministry of Trade and Industry
MOWAC	Ministry of Women and Children
MRP	Mineral Reserve Plant
NAMAs	Nationally Appropriate Mitigation Actions
NBSSI	National Board for Small Scale Industries
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
NEDCO	Northern Electricity Company
NES	National Electrification Scheme
NFAG	National Fishermen Association of Ghana
NPA	National Petroleum Authority
PUE	Productive Uses of Energy

PURC	Public Utility Regulation Commission
PV	Photovoltaic
REA	Rural Electrification Agency
REF	Rural Electrification Fund
SE4ALL	Sustainable Energy for All
SEAAF	Sustainable Energy for All Acceleration Framework
SECO	Swiss Agency for Economic Affairs
SHEP	Self-Help Electrification Project
SMEs	Small and Medium Enterprises
TAPCO	Takoradi Power Company
TICO	Takoradi International Company
TTPP	Tema Thermal Power Plant
UN	United Nations
UNDP	United Nations Development Programme
VALCO	Volta Aluminium Company
VRA	Volta River Authority

EXECUTIVE SUMMARY

Ghana's current medium-term national development policy framework, the Ghana Shared Growth and Development Agenda (GSGDA), seeks to achieve and maintain macroeconomic stability, underpinned by a monetary policy framework that targets low inflation, in order to achieve increased levels of shared growth with job creation, lesser socio-economic inequalities and reduced poverty, and the achievement of MDGS targets.

A core objective of the country's economic policy therefore is to expand employment along with production so that the benefits of growth will be shared more widely. Low income households have few productive assets of their own except labour. Better employment opportunities will provide people with new, and often improved, sources of income. To achieve this however would require employment-intensive growth strategies that deliver widespread poverty reduction.

Ghana's economic performance has generally been impressive in recent years, with record growth of 14.5% in 2011 (as against a 7.7% growth in 2010) and inflation in single digits. In 2011, the growth performance was driven by the Industry Sector and achieved through the impressive growth of the Mining and Energy, boosted by new crude oil production.

Declining performance of the Manufacturing sub-sector poses the greatest challenge to the prospect of job creation since mining and quarrying, modern construction, electricity and crude oil tend to be capital rather than labour intensive. The largely informal Agricultural sector declined (with the exception of Cocoa sub-sector), partly caused by the reduction in reforestation activities; and the expansion of the Services Sector contribution to growth has been spearheaded by the modern telecommunication sub-sector and financial services.

The record cocoa crop was however not on account of (labour absorbing) increased acreage under cultivation but the outcome of increased yields on account of R&D and favourable weather conditions. The poor performance of the labour-intensive manufacturing subsector and the abysmal Hotels and Restaurants subsector may further dampen job prospects especially for the youth.

Though investment levels are high, the narrow focus of investment and its low productivity represent challenges to be overcome. The structure of exports has not changed very much as the country continues to be dependent on primary resource-based products of gold, cocoa and timber, making export revenues vulnerable to international market prices and domestic production conditions such as the vagaries of the weather. The challenge of diversifying exports to achieve sustainable growth and jobs is even more important now that Ghana has also become an oil-producing country. This requires that much more attention is given to developing the non-oil sectors of agriculture and manufacturing.

The structure of the private sector has also remained unchanged with a few FDIs and a few competitive small and medium enterprises (SMEs) contributing to job creation, whilst bulk of

employment is generated in the large and growing informal sector where under-employment is high and productivity low.

Whilst the private sector is the largest employer, most of the jobs are created in the informal sector. Only about 16% of the total workforce is employed in the formal sector, equally divided between formal private enterprises and the public sector (including state owned enterprises. It is said that about 27% of the workforce is self-employed in non-agricultural activities and the remaining 56% is employed in the agricultural sector, mainly on small-holder farms. The majority of resources in the informal urban sector are employed in retail trade. Under-employment among non-agricultural workers is estimated to be 45% and is concentrated in urban areas.

The critical challenges at the macro level include how to translate growth into substantial jobs in order absorb the mounting pressure of widespread unemployment in a youthful population; limit the potential risk of over-reliance on new found crude oil revenue; and address poverty in the North. Despite progress made in overall poverty reduction, poverty rates remain stubbornly high in the three northern regions, contributing to persistent rural-urban and north-south migration. The main external risk is the negative impact on economic growth and the balance of payments from weaker commodity prices and foreign inflows that could result from a deeper global slowdown.

It is within this context that Ghana is prioritising the acceleration of sustainable access to clean modern energy for households and productive uses as a means of achieving accelerated growth that is shared through job creation and poverty reduction. Effective and sustained access to energy plays a significant role in improving people's living conditions, and contributes to economic and human development. Energy provides services to meet many basic human needs, particularly heat, mechanical power (e.g. water pumps and transport) and light.

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 (See Figure 2.2). About 82,000 communities, covering 8 million people, remained un-electrified. As at 2011, the national coverage had risen to 72%. Targets have also been set for the contribution of renewable energy to the energy mix to more than double, and the needed legislation has recently been passed, implementation of which will set Ghana on course to achieve this target.

The situation and emerging opportunities for realizing SE4AL goals in this regard is comprehensively assessed, even though in the light of the above, the Ghana SE4ALL Country Action Plan concentrates initially on two main sources of clean modern energy - Liquefied Petroleum Gas and Improved Cookstoves. The two are considered to have limited bottlenecks that can cost-effectively be removed through concerted action over the short to medium term. In additional they are adaptable to the needs and existing consumption/buying behaviour of rural and peri-urban households - with better end-user research and targeted investments to expand supply capacity and stimulate effective demand.

Increasing productive uses of energy is also regarded as a major challenge to be addressed if sustainable demand with pro-poor outcomes is to be generated, and considering that effective access to energy by the poor is often hampered by weak purchasing power. The thrust of projects proposed under the Ghana SE4ALLCountry Plan is two pronged - the development and promotion of small-scale productive opportunities for value-addition in communities, and the use of mechanical power to enhance production and efficiency.

It is significant to note that Ghana has set its sights on achieving SE4ALL goals and targets by 2020.

The Country Action Plan recognizes the need for partnership building and concerted action by government, civil society, research community and the private sector. Numerous challenges exist to realizing widespread employment-intensive growth and poverty reduction in Ghana. Major constraints include access to credit, inadequate infrastructure, the need for basic skills and training, limited access to markets, technology gaps, supply-side problems of production, insufficient information, and insufficient institutional capacity. Resolving these challenges requires coordination across numerous policy areas and cannot be addressed within the specific provisions of targeted programmes and projects.

The implementation arrangements of the Country Action Plan are therefore designed to reflect this reality by giving all stakeholders a platform to contribute their quota to ensure that the acceleration solution yields maximum impact. The main Country Plan implementation vehicle are the specified Prioritised Interventions, each with costed acceleration solutions or projects designed to address a set bottlenecks. These projects are to be carried out by designated implementation agencies, supported by a coordinating secretariat, within a given timeframe. Oversight is provided by an Inter-Ministerial Committee, which monitors and directs the implementation of the Country Plan through the work of its Sub-committees, constituted to supervise the Prioritised Interventions.

1.0 INTRODUCTION

1.1 BACKGROUND

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

Indeed, there is a direct relationship between the absence of adequate energy services and many poverty indicators such as infant mortality, illiteracy, life expectancy and total fertility rate. Inadequate access to energy also exacerbates rapid urbanisation in developing countries, by driving people to seek better living conditions.

Despite this, 1.3 billion people lack access to electricity and 2.7 billion people rely on traditional biomass for cooking and heating (IEA, 2011). With more than one-third of a household's budget being set aside for fuel costs in many countries in Sub-Saharan Africa, the region's population pays an onerous price for fuel (mainly biomass) that is of poor quality and not very effective.

The International Energy Agency (IEA) has forecast that use of traditional biomass will decrease in many countries, but it is likely to increase in South Asia and sub-Saharan Africa alongside population growth. Overall, the IEA forecasts that by 2030, the total number of people reliant on biomass will not have changed significantly. While the use of traditional energy sources is not necessarily undesirable in itself, concerns have been raised over how they are currently being used.

Modern energy sources, such as electricity and petroleum-based fuels, generally provide only a small part of the energy use of poor rural people. This is mainly because they are too expensive and because it is difficult to achieve regular supplies to isolated rural communities. The predominance of traditional fuels for cooking however takes a heavy toll on the environment through desertification and soil erosion, and the absence of modern fuels propels the poverty spiral further downward.

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 (SE4ALL) 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 of this initiative 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.

Though energy is not explicitly taken into account in the Millennium Development Goals (MDGs), it is widely acknowledged that access to reliable, better and sustainable energy services for all could contribute immensely to the achievement of all the MDGs. Reaching the MDGs requires a broad set of interrelated actions that can be divided into nine areas of activity often termed 'investment clusters':

- Rural development—increasing food output and rural incomes
- Urban development—promoting jobs, upgrading slums, and developing alternatives to new slum formation
- Health systems—ensuring universal access to essential health services
- Education—ensuring universal primary education and expanded post-primary and higher education,
- Gender equality—investing to overcome pervasive gender bias
- Environment—investing in improved resource management
- Science, technology and innovation—building national capacities
- Cross-national infrastructure—trade integration and government co-operation
- Public sector management.

Investments in improved energy services are critical for supporting each of the clusters identified above.

1.2 GHANA'S DEVELOPMENT POLICY

Ghana has mainstreamed the MDGs into the country's successive medium-term national development policy framework, Ghana Vision 2020: The First Step (1996-2000); the First Medium-Term Plan (1997- 2000), the Ghana Poverty Reduction Strategy (GPRS I), 2003 – 2005, the Growth and Poverty Reduction Strategy (GPRS II), 2006–2009, and currently the Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013. In addition to direct poverty reduction expenditures, government expenditure outlays have also been directed at policies and programmes to stimulate growth, which have high potential to support wealth creation and sustainable poverty reduction.

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 Government of Ghana through its current medium-term national development policy framework, the Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013, seeks to maintain macro-economic stability and generate higher levels of shared growth in order or to reduce socio-economic inequalities, ensure rapid reduction in poverty and accelerate the achievement of the Millennium Development Goals. Employment and improved standards of living, especially for the marginalized are therefore a major priority outcome expected from the implementation of national and sector development policies, including energy policy.

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: i) accelerated agricultural modernisation and natural resource management; ii) oil and gas development; and infrastructure, energy and human settlements development. The key areas of policy focus in the medium to long-term for the oil and gas sub-sector are: employment creation; protecting the environment; revenue management and transparency; diversification of the economy; capacity development; and increasing access to petroleum products. 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.

1.3 SEAAF CONCEPTUAL FRAMEWORK AND CAP METHODOLOGY

Within the context of the implementation of the International Year of Sustainable Energy for All 2012 at the national level, UNDP, in collaboration with other partner agencies, is providing support to some countries, including Ghana, to accelerate progress on the achievement of universal access to sustainable energy by 2030. In connection with this, Ghana has adopted a Sustainable Energy for All Acceleration Framework (SEAAF) 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 intended to 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.

Under the SEAAF, the Energy Commission in Ghana, with the support of the UNDP Country Office, has coordinated consultations with key stakeholders to develop a comprehensive plan of action, comprising critical actions and commitments to address prioritized needs in the energy sector towards the attainment of the objectives of SE4ALL. The process involves activities leading to three key outputs, namely:

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

- Prioritized commitments and a Country Action Plan (CAP) for Ghana, broadly agreed upon with implementing partners; and

- Draft Partnership Agreements for implementation of the Country Action Plan.

The conceptual framework and methodology for developing Ghana's Country Action Plan on SE4ALL draws many lessons from the UNDP UNDG MDG Acceleration Framework (MAF) and Country Action Plan (2011), and it served as useful model that was adapted to context for the Ghana SEAAF's technical and analytical approach, consultative processes and structure.

1.4 SEAAF OBJECTIVES

The key objectives of the SEAAF adopted by Ghana towards the attainment of SE4ALL are to:

- review existing policies and interventions in the area of SE4ALL
- identify the key bottlenecks to the implementation and attainment of the three UN SE4ALL goals by 2030;
- identify gaps in existing policies and interventions;
- develop cost-effective solutions that can accelerate progress towards the attainment of the SE4ALL goals by 2030; and
- design an action plan for implementing the indicative interventions and monitor progress.

1.5 METHODOLOGY USED IN PREPARING THE SE4ALL COUNTRY ACTION PLAN

An interactive and participatory approach was adopted for the SEAAF roll-out. A Technical team was set up by the Energy Commission to develop the Country Action Plan. A desk review of national policy documents, reports and roadmaps was undertaken covering universal access to energy, renewable energy and energy efficiency. Consultative meetings with a Multi-Stakeholder Consultative Group (see Appendix) were organized to review the initial findings (in terms of interventions and bottlenecks). The key interventions, bottlenecks and solutions were prioritized using the method of ranking (high/medium/low) and selection criteria (impact, sustainability, speed, resources). Based on the findings, the technical team worked during workshops and consultations to develop the draft Country Action Plan, which was then validated at a Multi-Stakeholder Meeting.

1.5.1 SEAAF Consultative Process

The process of the SEAAF roll-out, including the preparation of the Country Action Plan, was nationally driven, interactive and participatory, and carried out under the overall leadership of the Energy Commission and the Ministry of Energy. Ownership was further enhanced by engaging multiple stakeholders drawn from key sector ministries, civil society organisations, the private sector as well as the UN Country Office and development partners involved in supporting energy sector interventions.

1.6 COUNTRY OVERVIEW

Ghana occupies an area of 239,000 sq km and has a population of 24.9 million (Human Development Report, 2011 estimate), with a relatively high annual growth rate of 2.4% compared to 1.6% for other lower-middle income countries, but in line with the 2.5% average for Sub-Saharan Africa. The country has a diverse and rich resource base that include gold, timber, cocoa, diamond, bauxite, and manganese. 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. Figure 1.1 shows the map of Ghana showing the ten Regions and their Capitals.

In 2010, 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).

Figure 1.1: Map of Ghana showing the Ten Regions and their Capitals

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.

Agriculture is predominantly practiced 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). 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. The potential area – including inland valleys – that could be developed for irrigation is estimated at 500,000 ha, but the total area under formal irrigation is under 5%. 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.

Most Ghanaians sustain their livelihoods by participating in the economy either through agriculture which absorbs more than half of the adult labor force mainly as small-scale farmers, or the growing informal sector made up of small traders and artisans. Most of the non-agricultural employment created are in the form of increased self-employment in the informal sector or poorly remunerated jobs for unskilled workers. An overwhelming proportion of the working population still lack formal jobs and are stuck in low productivity and low income employment.

Despite the progress made in economic growth and the significant decline in poverty at the national level, regional, occupational and gender disparities exist. Some regions did not record improvements in poverty, particularly the three Northern regions where high levels of poverty persist. Over 70 percent of people whose incomes are below the poverty line live in the Savannah areas. The 2009 Human Development Report (HDR) shows Ghana's Human Development Index (HDI) rank had declined and inequality remained high. Thus the high growth rate has not necessarily been consistent with improved human development indicators as the country continues to face challenges in health and other social services.

The private sector is characterized by an extremely dualistic structure with many micro and small companies and large enterprises, with very few medium sized companies. Small firms, employing up less than 100 people each, account for 67% of total employment in manufacturing. In this group, the large proportion of micro firms with less than 10 employees account for the low value added per worker (US$ 1,000) in Ghana. Medium sized firms, employing between 100 and 199 workers, employ only 7% whilst larger firms employ 27%. This missing middle of medium sized firms is a contributory factor to the low productivity of the economy as value added per employee rises with the size of firm.

The share of Ghanaian SMEs that access credit from a commercial bank is quite small - only 13% of small enterprises and about 37% of medium firms. Bank credit is not a major source of financing for either working capital or investments. Indeed, SMEs finance only about 3-15% of their working capital needs through banks, while a higher share (about 19%) comes from supplier credit. Similarly, about 85-90% of the investment needs of SMEs are financed through internal sources, while bank finance helps only cover 10% or less.

Ghana's growth performance in 2010 was driven by the industrial sector with a 7% growth rate, achieved largely through the impressive growth performance of the mining and energy sub-sectors. The manufacturing sub-sector continued to record poor growth in 2010 with a growth rate of 1.0%, up from -1.3% in 2009. In 2010 agriculture grew at 4.8%, a decline from 6.1% in 2009. However, cocoa output continued to be strong, recording nearly 640,000 tonnes in 2009/10 to follow the peak production of 710,000 tonnes/year in 2008/9. The services sector recorded a 6.1% growth in 2010 compared with 5.9% in 2009. Financial services and expansion in the telecommunications industry continued to spearhead growth of the sector in 2010.

Ghana's high level of dependence on the world economy, with as much as 30% of budget support from international partners, and her strong trade links with the US and Europe, may imply that any disturbance emanating from the international financial system is bound to have an effect on the domestic economy. In terms of international trade and foreign direct investment, the global financial crisis did not create a major setback as far as Ghana is concerned. Gold and cocoa, Ghana's main exports, were resilient in the face of the crisis and as a result of investments in the oil and gas fields, foreign direct investment increased. It cannot therefore be argued that developments in international trade and FDI negatively affected the achievement of any of the MDGs in Ghana. However, the crisis brought with it negative consequences for the financial markets. Banks have been reluctant to provide credit to households, to small and medium enterprises (SMEs) as well as to big businesses, for fear of loan defaults. In addition, discount, interest, prime and lending rates remain high.

The impact of climate change is now more than ever before being felt. There is clear evidence that the potential negative impacts of climate change are immense, and Ghana is particularly vulnerable due to its relatively low capacity to undertake adaptive measures to address environmental problems and the socio-economic costs of climate change (EPA, 2000). Studies by the Environmental Protection Agency (EPA) have revealed that all the major sectors of the Ghanaian economy (including the energy sector) are very sensitive to climate change and variability. Although climate change presents challenges to achieving sustainable development, there are also opportunities for social and economic development.

Addressing sustainable energy access acceleration issues in Ghana by incorporating climate change and variability could have the following advantages:

- Reduction of GHG emissions through efficient and effective energy production, distribution and consumption technologies and practices;
- Participation of broader/wider stakeholders including the private sector and gender due to the multi-sectoral nature of climate change; and
- Building effective adaptive capacities of vulnerable groups, individuals, institutions and resilient energy infrastructure to withstand the impacts of climate change and variability.

For instance, in agricultural areas, particularly in the central and northern regions of the country, climate change has contributed to the deterioration of rural livelihoods, reflected in declining incomes, malnutrition and hunger. The flooding of coastal areas, which are already undergoing erosion, and low operating water levels of the only hydro-generating dam in the country are further problems. The vulnerability of people to daily shocks and stresses is intrinsically tied to the human adaptive capacity — and strategies created — to respond to floods, high temperatures, coastal erosion, rises in the sea level, and other climate-related events. Climate change is likely to exacerbate these shocks and stresses, particularly among the poorest and most vulnerable populations and, therefore, may inhibit the attainment of the MDGs.

Strategic actions are being pursued in Ghana towards the abatement of climate change, in a collaborative effort between the Ministry of Energy, the Ministry of Environment, Science and Technology and the Environmental Protection Agency, with the key objectives to:

- Promote the use of environmentally friendly energy supply sources such as renewable energy (solar, wind, waste) in the energy supply mix of the country;
- Encourage a shift from oil to gas wherever gas is a technically feasible alternative;
- Promote the use of improved woodfuel stoves for cooking in households and other commercial activities;
- Support and actively participate in international efforts and cooperate with international organisations that seek to ensure sustainable delivery of energy to mitigate negative environmental impacts and climate change;
- Encourage and enable all relevant entities engaged in activities in the energy sector to explore and access international environmental financial mechanisms and markets to overcome investment, technology and other relevant barriers; and
- Ensure effective disposal of all hazardous substances and materials associated with the production, transportation and use of energy; and
- Facilitate environmental protection awareness programmes.

Energy efficiency and renewable energy are often referred to as the “twin pillars” of sustainable energy policy. With respect to the promotion of energy efficiency, the Legislative Instrument LI 1815 Energy Efficiency Standards and Labelling (Non-Ducted Air-conditioners and Self-Ballasted Fluorescent Lamps) Regulations, was passed in 2005 promote the use of energy efficient air conditioners and fluorescent lamps. In 2008, a follow-up Legislative Instrument - LI 1932 Energy Efficiency (Prohibition of Manufacture, Sale or Importation of Incandescent Filament Lamp, Used Refrigerator, Used Refrigerator-Freezer, Used Freezer and Used Air-conditioner) Regulations – was passed to discourage the use of incandescent lamps, used refrigeration appliances and used air conditioners. This was again followed in 2009 by the passage of the Legislative Instrument LI 1958 Energy Efficiency Standards and Labelling (Household Refrigerating Appliances) Regulations. In 2011, Ghana also passed the Renewable Energy Act, 2011 (Act 832) to support the development, utilization and efficient management of renewable energy sources. The Act seeks to increase the proportion of renewable energy including solar, wind and biomass in the national energy supply mix and to contribute to the mitigation of climate change. A follow-up Country Action Plan on “Sustainable Energy for All”, with emphasis on the promotion of energy efficiency and renewable energy.

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

2. PROGRESS AND CHALLENGES IN ACHIEVING SUSTAINABLE ENERGY FOR ALL (SE4ALL)

2.1. OVERVIEW OF GHANA'S ENERGY SECTOR

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. In terms of primary energy consumption in 2011, 6,138 ktoe (54.2%) was from woodfuels, 3,767 ktoe (33.3%) from oil, 772 ktoe (6.8%) from natural gas, and 650 ktoe (5.7%) from hydro. The total energy consumption was 11,327 ktoe, which is equivalent to 0.47 ktoe per capita (Energy Commission, 2012). The vision of the energy sector is to develop an "Energy Economy" to secure a reliable supply of high quality energy services for all sectors of the Ghanaian economy and also to become a major exporter of oil and power by 2012 and 2015 respectively (Energy Commission, 2010a).

2.1.1 Electricity

Electricity 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 2.1). The electricity generation from the hydro source was 6,995 GWh, and the generation from thermal sources was 3,171 GWh (see Table 2.2). 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.

Table 2.1: 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**

*LCO - light crude oil

Source: Energy Commission, 2011

Table 2.2: 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

Distribution of electricity is undertaken by two distribution utilities – Electricity Company of Ghana (ECG) and Northern Electricity Distribution Company (NEDCo). 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 Aluminium 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.

NEDCo was established in 1987, originally 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.

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%. 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.

Table 2.3 presents the share of electricity supplied to the industrial, residential and non-residential sectors in 2000-2010. The share of electricity supplied to the industrial sector has decreased from 68% in 2000 to 46.6% in 2010 and indeed it was the sector most severely affected during the load shedding in 2003-4 and 2007. 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. However, the share of electricity supplied to the residential sector increased in from 24% to 39%, dropped in slightly in 2005-2006, continued increasing in 2007-2010. As at 2010 the share of electricity supplied to the residential sector was 40%.

Table 2.3: 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

Source: Energy Commission, 2011

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 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 Government of Ghana subsidises the lifeline consumers, and they use electricity free of charge. The average tariff for residential customers is currently about 10 US cents per kWh. A survey in 2006 conducted by the Ghana Statistical Service (GSS, 2008) observed that on the average, 4.8% of household expenditure was on electricity, LPG and other fuels. It is estimated that about 60% of this expenditure (2.9%) would be directly for paying electricity bills.

2.1.2 Petroleum Fuels

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. The shortfall in supply is compensated for through imports.

The consumption of LPG has been rising steadily from 45,000 tonnes in 2000 to 178,400 tonnes in 2010 (see Table 2.4). Gasoline, gas oil and other petroleum products also rose over the period. The consumption of kerosene however showed some fluctuations over the years.

Table 2.4: Consumption of LPG compared to other Petroleum Products (kilotonnes)

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

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 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.

2.1.3 Woodfuels

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 million tonnes, whilst that of charcoal was estimated to be 2.2 million tonnes in 2009

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 incur high levels of waste. According to the UN Food and Agriculture Organisation (FAO), the rate of deforestation in Ghana is 3% per annum (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 centres (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.

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, and 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 2.1). 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.

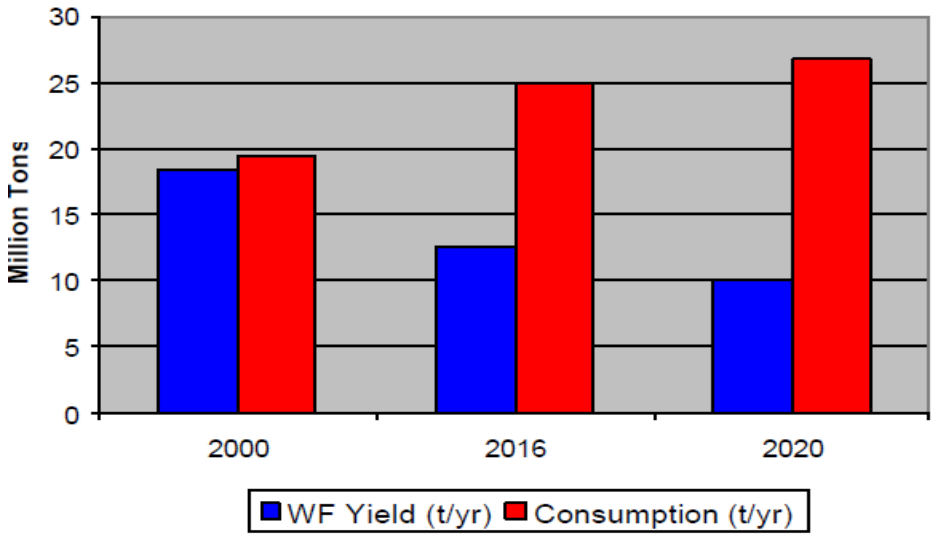

Figure 2.1: Woodfuel Balance of Ghana (2000-2020)
Source: Energy Commission (undated)

An Energy Use Survey conducted by the Energy Commission in 2010 estimated that about 40.3 % of households in the country use firewood for cooking but the proportion of households in rural areas using firewood for cooking is much higher (62.1%) than in urban areas (25.8%), and also much higher in the Savannah (71.5%) than in the Forest areas (57.2%) and Coastal areas (52%). On average a household in Ghana uses 1,064.7kg of firewood annually, but there are regional and rural/urban disparities. 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.

About 78.8% of households in the country use charcoal. The Northern Region has the highest proportion of households (90.5%) using charcoal. About 80.1% of urban households surveyed use charcoal whilst in rural areas, 76.1% of households use charcoal. 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.

2.2. OVERALL ASSESSMENT OF PROGRESS TOWARDS SUSTAINABLE ENERGY FOR ALL

2.2.1. ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

2.2.1.1 Universal Access to Electricity

Electricity is largely used in the residential sector, which accounts 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 6-7% per annum. 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 (See Figure 2.2). About 82,000 communities, covering 8 million people, remained un-electrified. As at 2011, the national coverage had risen to 72%.

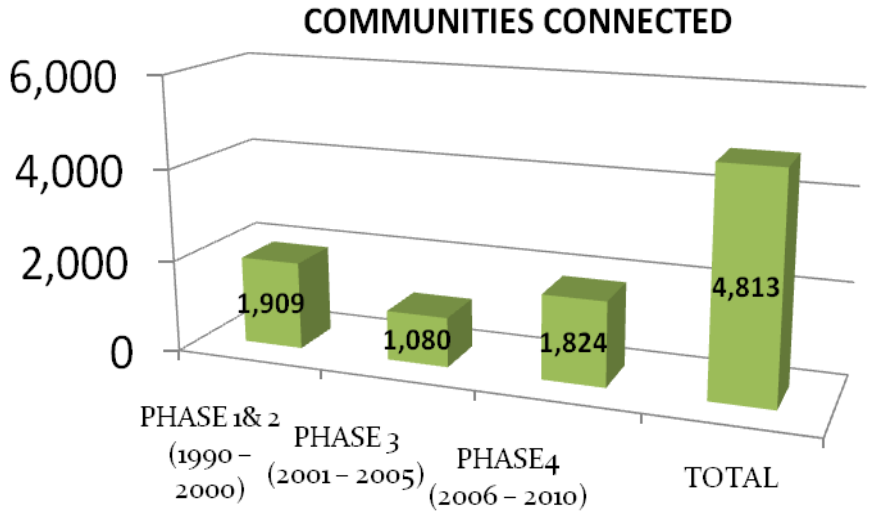

Figure 2.2: Communities with Electricity Connection
Source: Ministry of Energy, 2011

The goal of Government is to ensure that 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 National Electrification Scheme.

2.2.1.2 Modern Energy for Cooking

In 2010, 40.2% of households used fuelwood as main fuel for cooking, 33.7% used charcoal, and only 18.2% used LPG (Ghana Statistical Service, 2012). 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 woodfuel 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. Some programmes have also been organized to train traditional charcoal producers on more efficient methods of charcoal production.

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, 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. The foregoing issues underscore the need to intensify efforts to promote the use of modern energy for cooking, i.e. the use of cleaner fuels such as LPG, and improved cookstoves.

2.2.1.2.1 Promotion of LPG

LPG is a clean burning fuel and has lower greenhouse gas emissions and net warming impact per unit of energy delivered compared with woodfuels burned in a cookstove. LPG also produces substantially less particulate matter and NO_X than woodfuels, and its use poses less negative impact on indoor air quality and the health of the household.

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 9.5% of Ghanaian households used LPG as the main source of fuel for cooking. Figure 2.3 shows the location of LPG retail stations across Ghana.

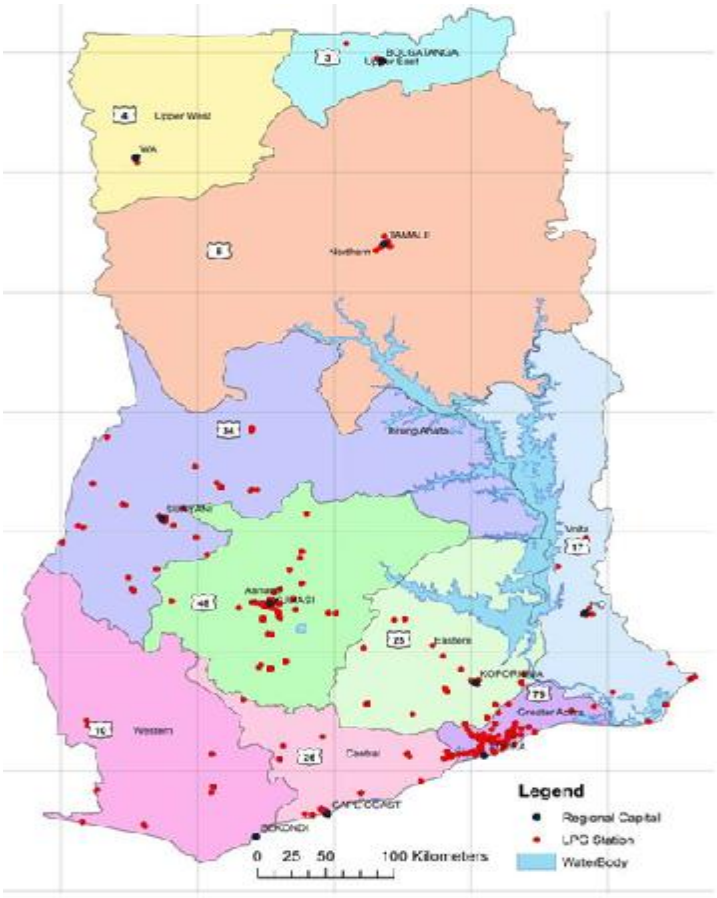

Figure 2.3: Location of LPG Retail Stations across Ghana
Source: TEC/EUEI-PDF Study, 2011

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 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.

2.2.1.2.2 Promotion of on Improved Cookstoves

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 2.4 and 2.5). 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.

In the beginning of the 1990s, the Ministry of Energy undertook comprehensive field and laboratory tests on the *Ahibenso* stove (see Figures 2.6 and 2.7). 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 2.4: CSIR-IIR Improved Firewood Stove

Figure 2.5: Toyola Improved Firewood Stove

Figure 2.6: Traditional Charcoal

Figure 2.7: 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).

Other initiatives on the promotion of improved charcoal stoves have been implemented by Enterprise Works Ghana, Climate Care and Toyola Energy Limited (indigenous private

sector firm). The initiative of Enterprise Works Ghana commenced in 2002, and it has sold over 480,000 stoves (as at 2011) 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 2.8 and 2.9). 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.

Figure 2.8: The Gyapa Stove

Figure 2.9: A Retail Shop displaying Traditional and Improved Stoves

Climate Care (an NGO) also promoted the *Gyapa* stove, and carbon finance allowed 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. The project is currently benefiting from carbon financing.

The improved charcoal stove manufactured and marketed by Toyola Energy Limited is also based on the *Gyapa* design using a ceramic liner in a casing made from scrap metal. 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.

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.

2.2.1.3 Modern Energy for Productive Uses

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 that 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. The promotion of productive uses of energy is an important aspect in the design and implementation of rural energy projects.

The National Electrification Scheme (NES) was to be accompanied by an aggressive Productive Uses of Energy (PUE) programme. The nation's efforts under the PUE component of the NES since 1989 can be summarised as follows:

- Organization of public forums on productive uses of electricity in newly electrified communities;
- Socio-economic study on 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 non-government 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.

The long-term sustainability of projects on productive uses of energy could be facilitated by greater involvement of the private sector. However, private sector buy-in of the projects has

been weak due to uncertainty on the economic viability of the projects. Technical support on the preparation of comprehensive business plans on proposed projects would encourage the private sector to take up some of the projects.

2.2.2 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 slow down of the growth in the demand for electricity. In an attempt to address such situations in the ECOWAS sub-region, the ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE) is developing a regional policy on energy efficiency to support a regional activity to promote energy efficiency which includes strategies to reduce electricity transmission, distribution and end-use.

2.2.2.1 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. The programme was financed by the Government of Ghana. All 6 million lamps were distributed to households for free 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 savings of US$107,107 per day, or US$38,558 million per annum; and
- Reduction of 116,000 tonnes 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 Energy Efficiency Global Visionary Award in 2010, as the first African country to undertake such an initiative (Energy Commission, 2010). Two factories have now been established to produce CFLs in Ghana.

Legislative Instruments - LI 1815 Energy Efficiency Standards and Labelling (Non-Ducted Air-conditioners and Self-Ballasted Fluorescent Lamps) Regulations, 2005 and LI 1932 Energy Efficiency (Prohibition of Manufacture, Sale or Importation of Incandescent Filament Lamp, Used Refrigerator, Used Refrigerator-Freezer, Used Freezer and Used Air-conditioner)

Regulations, 2008 (as mentioned in Section 1.6) were introduced by the Government to support the banning of inefficient incandescent lamps in Ghana.

2.2.2.2 Power Factor Improvement

As part of measures adopted by government to reduce recurrent expenditure, the Ministry of Energy embarked on installing Power Factor Correction equipment in five public tertiary institutions, namely University of Ghana, Legon, University College of Education, Winneba, GIMPA, University of Cape Coast and KNUST. The total cost of the installations in all the five public institutions was GH¢190,000 (US$ 210,140). Compared to the electricity cost profile before the installation, the University of Ghana is saving an average of GH¢64,149 (US$71,374) a month, as result of the reduction of the maximum demand from 4,660 kVA to 2,180 kVA. This means that the cost reduction for the University of Ghana alone is enough to pay for the installations in all the five tertiary institutions in less than four months. As a result of the installation at the University of Ghana, Legon, Power Factor improved from an average of 0.83 to 1, and the Power Factor Surcharge which averaged GH¢2,850 (US$ 3,171) per month has been totally eliminated.

2.2.3 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 urban and peri-urban sanitation problems.

2.2.3.1 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. Table 2.5 presents the biomass-fired co-generation plants in Ghana.

Table 2.5: Biomass-fired co-generation plants in Ghana

Plant Location	Installed Capacity, kW	Average Annual Production, GWh
Ghana Oil Development Company, Kwae	2,500	6.8
Juaben Oil Mill, Juaben	424	1.5
Benso Oil Mill, Benso	500	1.9
Twifo Oil Palm	610	2.1

Source: Energy Commission, 2011

2.2.3.2 Solar Energy

Solar radiation and sunshine duration data have been collected by the Ghana Meteorological Services Agency for over 50 years. The daily irradiation data has a probable error of 15%. Currently the Mechanical Engineering Department at Kwame Nkrumah University of Science and Technology, Kumasi 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)

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 (see Figure 2.10). Table 2.6 presents solar PV installations in Ghana. Over 4,500 solar systems have been installed in over 89 communities throughout the country.

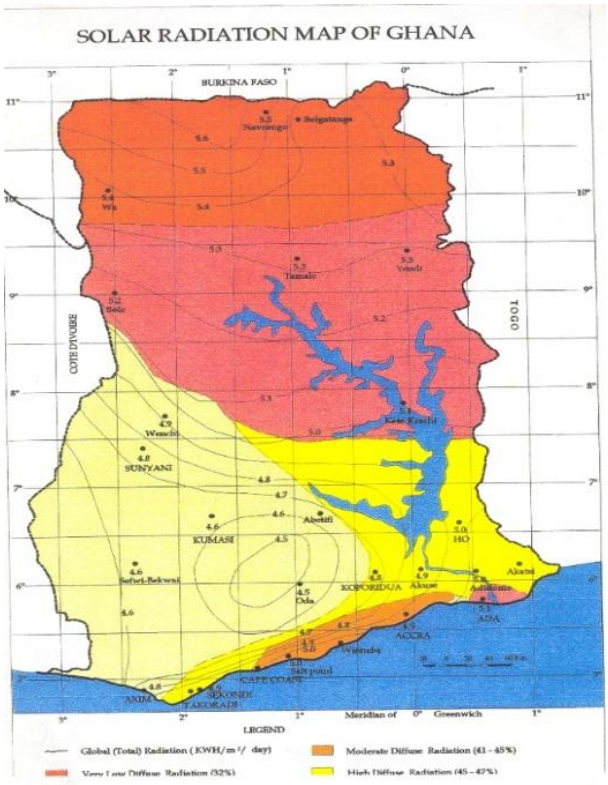

Figure 2.10: Solar Resource Potential of Ghana
Source: Ministry of Energy, 2011

Table 2.6: Solar PV Installations in Ghana

Solar PV Systems	Installed Capacity, kW	Average Annual Production, GWh
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 system	60	0.10-0.12
Solar streetlights	10	0.04-0.06
Total	**853**	**1.34-1.82**

Source: Energy Commission, 2011

These 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 distance education; Solar Streetlight System for lighting general meeting points, such as markets, lorry stations, water supply points and important busy paths/roads requiring visibility; Solar Water Pumping System for the provision of water and

irrigation; Solar Battery Charging System for charging automotive batteries for operating TV and radios in rural communities; Solar System for communication and centralized solar system for providing AC power into the grid; and Solar Water Heating Systems. Currently, the Volta River Authority is erecting 10MW Solar Power Plant in northern Ghana that is expected to be commissioned in 2013.

2.2.3.3 Wind Energy

Ghana has about 2,000 MW of raw potential for wind energy as shown in the Wind Energy Resource Map of Ghana in Figure 2.11. 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 8m/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. 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. The Volta River Authority is erecting a 100MW Wind Power Plant at Kpone, near Tema that is expected to be commissioned in 2015.

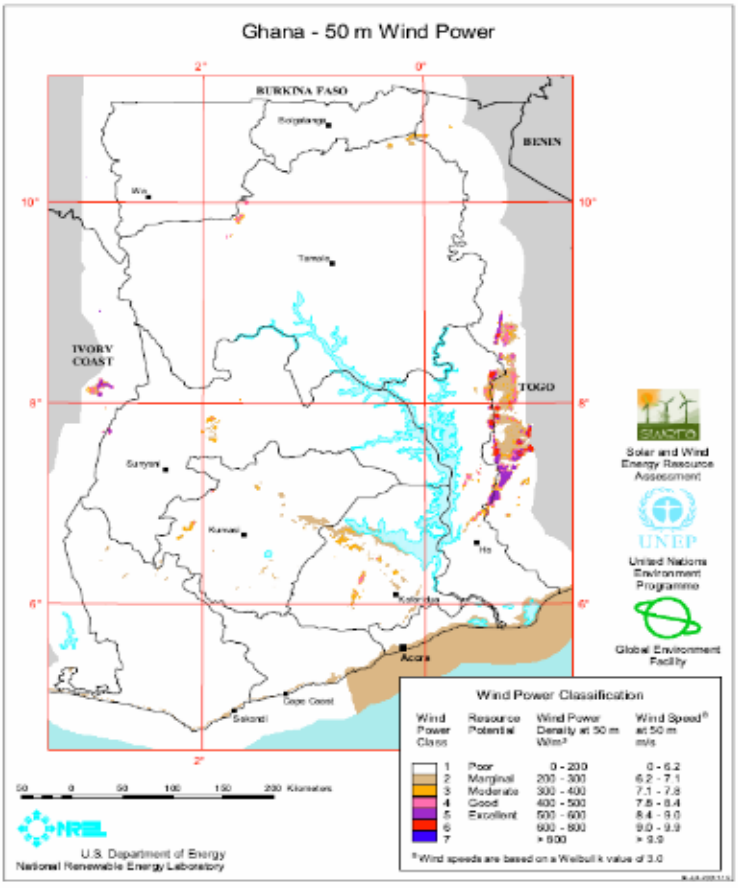

Figure 2.11: Wind Resource Potential of Ghana
Source: Ministry of Energy, 2011

2.2.3.4 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 2.12. Ghana has two large hydroelectric plants, Akosomobo 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, and it expected to be commissioned in 2013. 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.

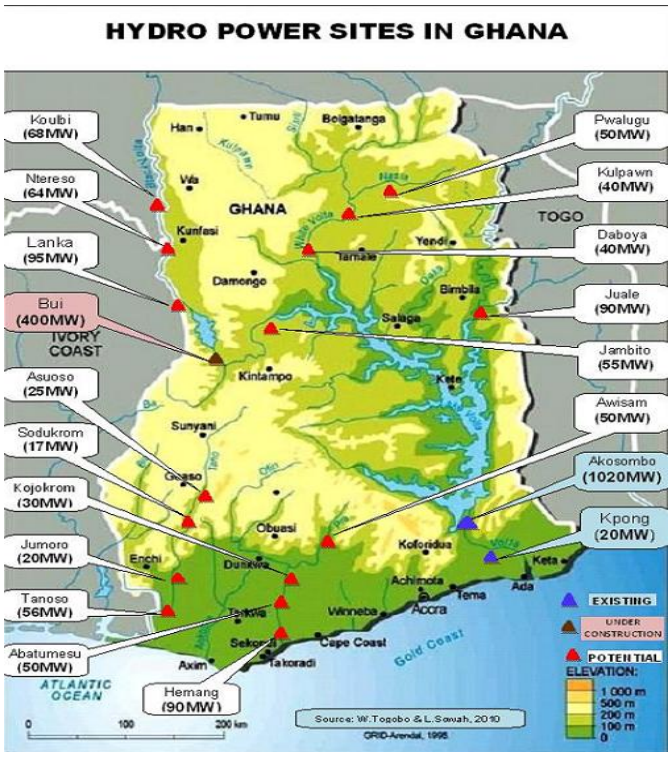

Figure 2.12: Hydropower Sites in Ghana
Source: Energy Commission, 2010
*Capacity of Kpong Hydro Plant is 160MW

2.2.3.5 Agro-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. There are two types of agro-fuels: crop residues and animal waste. 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 (Energy Commission, 2011). It was estimated in 2000 that energy that could be harvested from various products was: 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.

2.2.3.6 Municipal Waste

Municipal waste is generated in large quantities, particularly in urban areas. For example, Kumasi and its suburbs generate up to 1,600 tonnes daily while Accra and its environs generate up to 2,500 tonnes daily. In general, municipal waste generation in the metropolitan centres varies from 600-800 tonnes per day (Energy Commission, 2011).

3. STRATEGIC INTERVENTIONS

3.1 STRATEGIC INTERVENTIONS OF HIGH IMPACT FOR THE ACHIEVEMENT OF SE4ALL GOALS

3.1.1. Universal Access to Energy

3.1.1.1 Electricity to Communities and Households

Ghana has made considerable gains in respect of expanding access to electricity and has major ongoing programmes that are likely to lead to the achievement of universal access to electricity before 2030. The key strategy in this respect has been to expand coverage to all communities thereby offering opportunity for households and productive users to get connected.

Only 28% of communities remained unelectrified as at the end of 2011 and coverage of all communities (100%) is expected to be achieved in 2020. However, in terms of translating coverage of communities into effective household demand, only 64.2% of households in electrified communities were actually connected, as at 2010 (Ghana Statistical Service, 2012). Thus access to electricity is a function of availability and affordability, where electricity is considered to be available if the household is within the economic connection and supply range of the electricity grid, and electricity is affordable when the household is able to pay the up-front connection cost (or first cost) and electricity usage costs (tariff). In this context, the up-front cost discourages some poor households from making a switch to a modern energy form (electricity) even though this may be available, denying the household access to that modern energy. Innovative strategies need to be developed to increase the deployment of electricity to poor households.

Major on-going interventions with high impact towards universal access to electricity are highlighted in the sections below.

3.1.1.1.1 National Electrification Scheme (NES)

Ghana initiated a 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.

3.1.1.1.2 Self-Help Electrification Project (SHEP)

The SHEP is a complementary electrification programme instituted since 1989 to support the main National Electrification Scheme (NES), with the rationale of accelerating the connection of communities to the national electricity grid. 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.

3.1.1.1.3 Ghana Energy Development and Access Project (GEDAP)

GEDAP is a multi-donor funded project supporting Ghana 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. It is also supporting Ghana's transition to a low carbon economy through the reduction of greenhouse gas emissions (GHG). The project assists this transition through the development of renewable energy for the expansion of access to electricity. The main development partners funding the project are 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).

GEDAP comprises four principal components, including energy sector and institutional development, electricity distribution system improvement, transmission system upgrade, and more importantly for SE4ALL, electricity access expansion and renewable energy development.

The project's Electricity Access Expansion and Renewable Energy Development component is intended to support the introduction of multifaceted approaches 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 provides 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 will also 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: i) 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 ii) 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 created a Rural Energy Directorate at the Ministry of Energy which oversees national renewable energy interventions. The project will also 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.

3.1.1.2 Mechanical Power for Productive Uses

Considering that the ultimate goal of electrification is economic and social development, support for productive use of electricity is generally justified as a direct measure for enhancing the development outcomes of rural electricity access. Moreover, promoting productive uses can help to improve the economic and financial sustainability of rural electrification programmes and projects.

Widespread economic growth and social transformation has been an overall objective of energy policy in Ghana for several years, and was one of the major objectives of the National Electrification Scheme (NES) since it was launched in 1989. It was assumed that once electricity was provided to communities, there would be "productive uses of energy (PUE)" to boost local economic activity. However, the level of economic transformation that was expected to have resulted from electrification of districts and communities is yet to be realized at the projected levels. Only about half of households in electrified communities are connected, and the use of electricity in these communities is predominantly for domestic lighting purposes, generally consuming less than 50 kWh per month.

Agriculture, agro-industry and services are being targeted under the Energy Policy to enhance the productive uses of energy and ensure that development strategies and expected outcomes are achieved. Access to energy for major economic initiatives envisaged under the National Medium Term Strategy include expansion of irrigation, agro-processing (e.g. crop drying and milling), cold-chain refrigeration and ICT services. This however requires private sector partnership, community participation and effective multi-sectoral planning and coordination between all the key stakeholders in the energy sector and those in the agriculture, trade and industry, communication, science and technology and local government sectors.

Many NGOs and Community-based organizations (CBOs) have programmes targeting rural and peri-urban micro and small enterprises and others are being implemented with development partners' funding by the Ministries responsible for Energy, Trade and Industry, Women and Children's Affairs as well as Employment and Social Welfare, described as PUE, rural enterprise, MSME, women entrepreneurship, job creation and skills development projects. High impact could be generated by building partnerships, harmonizing approaches, pooling resources and sharing information on lessons learned, in order to address the common challenges of weak coordination, low implementation capacity, limited outreach, poor results monitoring, and lack of community participation, impact assessment and sustainability.

Particular attention needs to be paid to the energy needs and potential economic contributions of peri-urban communities since they seem to be growing at a much higher rate in some cases

than the rural populations. Even though electricity is a major input in the generation of entrepreneurial/economic activity, there are other important factors such as knowledge, skills and capital that need to be present for a successful outcome. Coordination with all stakeholders operating in critical sectors is essential.

In the specific case of PUE, affordability of the electricity provided to rural communities continues to plague efforts at getting households and productive users to translate access into improved livelihoods and economic development. The low consumption rates pose a significant challenge for continued investments in these communities by way of maintenance and other supply improvements.

In some successful models, community involvement has not been limited to consultation alone but rather through innovative schemes, community dwellers are able to actively participate in metering, billing and payment recovery as well as reducing losses due to theft. Setting aside funds over the long-term for the proper maintenance of the local electricity system will impact the efficiency of distribution, reduce losses and reduce the utilities' burden over the time it takes for services delivered to these communities to become financially viable. This will also require acceleration of the competitive commercial development and aggressive marketing of alternative energy sources such solar, biogas and briquettes, to expand the mix of energy choices and make them widely available to productive users, particularly those in rural communities.

Technical and financial assistance may encourage private actors to take advantage of electricity access for production processes and services. Measures geared to promote productive uses can therefore help translate electricity access into positive economic and social development outcomes in the form of increased incomes and employment, reduced workload, availability of higher quality products, and lower consumer prices because products can be supplied locally, etc.

The main economic sectors targeted for productive uses of energy (PUE) under Ghana's SE4ALL strategy are:

- Agriculture, primarily irrigation, cold storage refrigeration, power tools and equipment;
- Agro-processing, including but not limited to crop-dryers, mills and presses;
- Other non-farm enterprises, such as dressmaking, hair-dressing, auto-mechanics, welding and fabrication, electrical and electronic repair services, etc.; and
- Information and Communication Technology, including equipment maintenance and repair services and innovative value-added mobile telephony services (e.g. enhanced supply chain information and value chain management services for small-holder farmers and their suppliers, transporters, financiers, traders and processors).

3.1.1.3 Modern Energy for Cooking

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 woodfuels while ensuring that their exploitation does not lead to deforestation. Government also intends to promote the use of alternative fuels, like LPG as a substitute for fuelwood and charcoal by addressing the institutional and market constraints that hamper increasing access, including the regulation of taxes and levies on woodfuels by the appropriate national agencies or local authorities where 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 woodfuels, the strategies to be implemented by Ghana are:

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

In order to provide clear policy and regulatory support in respect of sustained regeneration of woody biomass resources through legislation, fiscal incentives, competitive pricing and establishment of dedicated woodlots for woodfuel production, the Renewable Energy Act, 2011 (Act 832) has recently been enacted. It comprehensively provides the legal framework for the development and use of more efficient biomass production and utilisation technologies.

With respect to developing specific national programmes to accelerate universal access to clean fuel alternatives and improved devices for cooking and heating, the promotion of LPG and Improved Cookstoves have been identified as primary strategic intervention areas of high impact.

3.1.1.3.1 Liquefied Petroleum Gas (LPG) Promotion Strategy

Ghana has implemented an LPG promotion programme since 1989. The experiences gained and recent developments of demand outstripping supply provides a strong basis for developing a new LPG strategy and policy towards the realization of the dual Government policy objectives to increase LPG access to households and public institutions and ensure 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.

The National Energy Policy of 2010 indicates that the Government intends to increase the access of households to LPG as main cooking fuels to 50% 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.

However, the Energy Commission has had to revise the projection of access of households to LPG, as presented in Figure 3.1. The figure indicates that under "business as usual," 50% access of households to LPG is not achievable by 2015, and the more realistic target for that year would be 18%; access of households to LPG in 2020 would be about 24%. However, with some comprehensive interventions 50% access of households to LPG may be achievable in 2020, as shown in the figure (see exponential curve in broken lines). In this context, the national LPG access target may have to be revised.

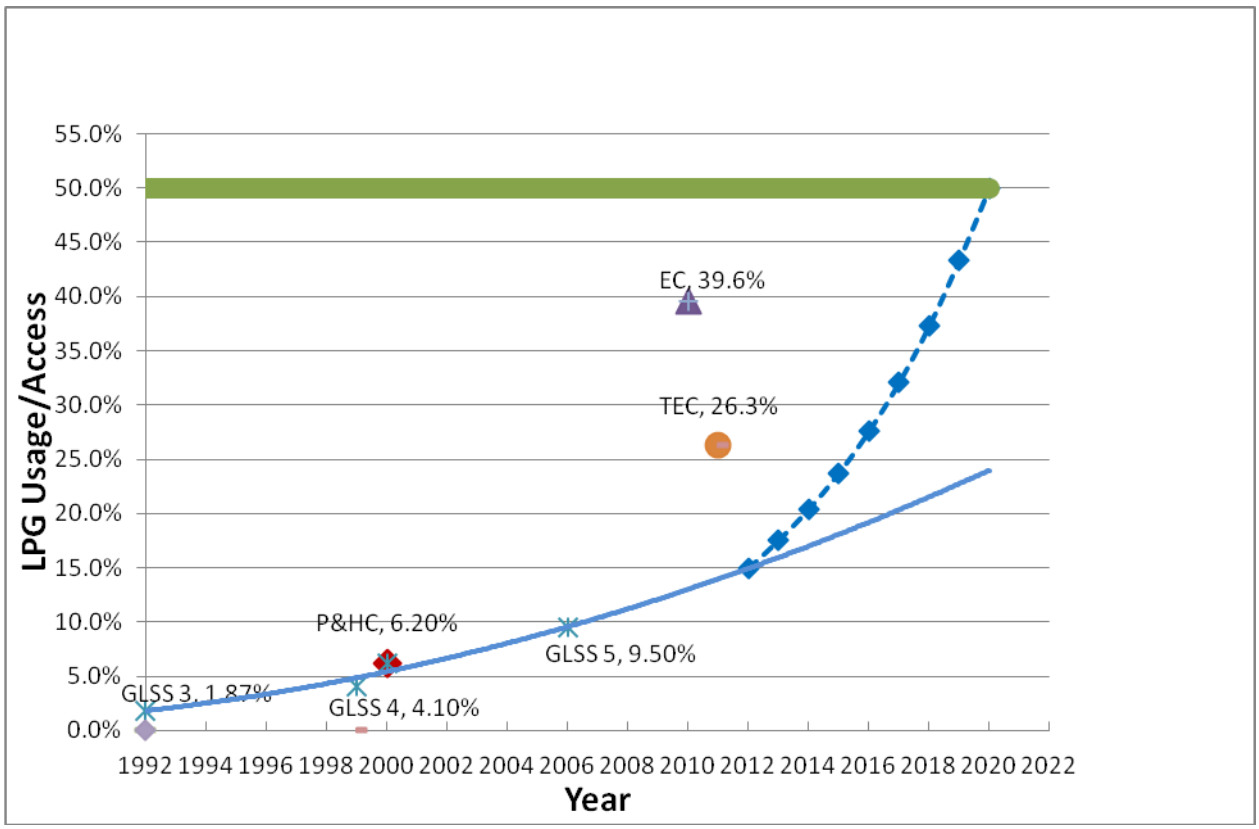

Figure 3.1: Revised Projection of LPG Access in Ghana
Source: Energy Commission, 2012

A major policy issue for the coming years up to 2020 will be the need for a major change in the current business model based on the establishment of LPG retail/bottle-filling stations across the country. A key policy shift to accelerate the rate of uptake of LPG for cooking would be a return to the “LPG bottle recirculation” model for the distribution of LPG where there would no longer be the need for the construction of LPG filling stations all over the country. Under the “LPG bottle recirculation" model,” consumers will not own their cylinders, but simply pay a deposit for the cylinders and exchange their empty cylinders for a cylinder filled with LPG on payment for the LPG.

It is expected that this change in the business model, combined with an increased availability of smaller cylinders (e.g. 2kg and 3kg bottles) and a number of additional measures to ensure that shortages of LPG in the country are permanently eliminated, will make LPG the preferred fuel for cooking in all urban and peri-urban areas of the country. Some fiscal measures (e.g. import duty waiver) could also be introduced to bring down the cost of LPG bottles to make the use of LPG by households more affordable.

The National Energy Policy strategies relevant to facilitating access to LPG are expanding supply infrastructure and increasing access by:

- expanding storage capacity, and extending bulk distribution infrastructure to all parts of the country;
- supporting expansion of the supply and reach of LPG to homes and small businesses; and
- addressing institutional and market constraints that hamper increasing access.

Specifically, in the Energy Sector Strategy and Development Plan, Government spelt out its intention to implement the following measures to support and accelerate the supply and use of LPG:

- 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;
- Re-capitalise Ghana Cylinder Manufacturing Company (GCMC) to expand production capacity with the production of cylinders focused on small sized cylinders that will be portable and affordable to households in rural communities;
- Construct LPG storage and supply infrastructure in all regional and district capitals in the long term, and to develop district capital LPG infrastructure in the medium term; and
- Increase the marketers/distribution margin on a sustainable and predictable manner for LPG.

These measures remain largely unimplemented with the exception of the first one where the Ghana National Gas Company (GhanaGas) has been established to build and operate a Natural Gas Processing Plant in the Western Region, which is estimated to produce 300,000 MT/yr of LPG from the Jubilee Oil Field in the first phase of the gas processing project to be completed by the end of 2012.

3.1.1.3.2 Improved Cook Stoves

Although past programmes set up to promote the widespread adoption of improved cookstoves underperformed in terms of outreach, cookstove manufacturing firms established in Ghana by the private sector continue to operate and cookstoves are now more commercially available. In addition, significant experience has been accumulated in developing and implementing small-scale and disaggregated financing programs. New financing instruments and sources, especially those linked to climate-change mitigation, have emerged, including the Global Environment Facility, Carbon Funds, and Climate Investment Funds. In addition, dialogue has begun between Government and local banks/financial institution to partner in structuring financing for the wider promotion and marketing of improved cookstoves by the private sector.

Internationally, coalitions supporting improved cookstoves and clean cooking such as the Global Alliance for Clean Cookstoves (GACC) led by the United Nations Foundation (World Bank, 2011) have emerged as result of a resurgence of interest in household energy use. Ghana is already a National Implementing Partner of the Global Alliance for Clean Cookstoves. Government, through public universities, polytechnics, research and technology institutions continues to support a limited range of promotional activities such as training artisans in the fabrication of cookstoves.

Heavy dependence on biomass for cooking and heating is also increasing the pressure on local natural resources and accelerating degradation. With the rapid increase of urbanization (currently 3.6%) (World Urbanization Prospects, 2009, UN, DESA) energy access will become a key urban issue as well in the near future with accelerated demand for wood fuel - especially charcoal - which is the fuel of choice for most urban residents in Ghana. However, unsustainable production and incomplete combustion of biomass is a significant contributor to climate change through the emission of greenhouse gases such as carbon dioxide and methane, and aerosols such as black carbon.

As the primary bearers of the burden of collection and use, women and children, are disproportionately exposed to health, safety, and security risks. Biomass use forces women and children to spend many productive hours each week gathering fuel wood. The UN-Energy report (2005) estimated that, in resource-depleted areas, people spend up to five hours gathering fuel wood, a burden that mostly falls on women and girls. Time spent on foraging for wood impedes investments in education and livelihood-enhancing activities.

More efficient stoves reduce biomass use, alleviating the impact on natural resources (forests, habitats, etc.) and on climate. At the same time, they reduce the time people (usually women and girls) have to spend collecting fuel. Cleaner stoves may last for several years, allowing the accumulated fuel savings to be spent on a range of livelihood-enhancing activities (e.g., income-producing enterprises for women, health care, and school attendance for children). Reductions in emissions achieved by clean cookstoves can also create potential revenues from carbon credits. More broadly, the entire clean cookstove supply-chain can be a potential source of economic opportunity and job creation at the local level.

Accessing and commercializing a new generation of clean cookstoves is therefore a pressing need for Ghana and is a critical step to promoting sustainable human development while tacking poverty and alleviating health-related risks and adverse environmental impacts.

Past programmes to promote improved cookstoves under-performed, mainly due to the following reasons:

- use of supply-driven project design models that were not driven by consumer research, stove design, market development, long-term financing and business growth; and
- lack of standards and quality control of the cookstoves.

The main factors to be considered in scaling up the adoption of improved cookstoves nationwide are:

- Needs and preferences of users, i.e. ensuring that cookstove designs are based on needs and preferences of the users, shape, color, and size;
- Durability and performance of devices, i.e. the need to ensure quality control and standards;
- Access to finance, i.e. facilitating credit for SME manufacturers of cookstoves and ensuring affordability for majority household consumers, including consumer credit;
- Stakeholder participation, i.e. ensuring active participation of the private sector, banks, communities, community-based organizations, government and NGOs;
- Public awareness, i.e. sustaining education, awareness and outreach activities to accelerate adoption; and
- Market-based programme design and implementation, i.e. ensuring relevant investment and marketing partners are in place for commercialization and scaling up.

3.1.2. Doubling the Share of Renewable Energy in the Global Energy Mix

Ghana faces the challenge to increase renewable energy in the national energy mix in a sustainable manner. Its goal is to increase the proportion of renewable energy, particularly solar, wind, mini hydro and waste-to-energy in the national energy supply mix and to contribute to the mitigation of climate change.

Ghana is well endowed with renewable energy resources, particularly biomass, solar and wind energy. The vast arable and degraded land mass of Ghana has the potential for the cultivation of crops and plants that can be converted into a wide range of solid and liquid bio-fuels. The development and use of renewable energy and waste-to-energy resources also have the potential to ensure Ghana's energy security and mitigate the negative climate change impacts. The use of waste-to-energy resources also has the potential to act as a significant part of the national sanitation programme.

As previously mentioned, by virtue of its geographic location, Ghana is well endowed with solar resources which could be exploited for both on-grid and off-grid electricity generation as well as low heat requirements in homes and industries. Even though the overall potential of mini-hydro is limited, 22 potential medium and small hydro power sites have been identified in the country that could be developed for power generation. The generating capacities of these sites range

between 4kW and 325kW. Solar energy utilisation has however been limited owing to its comparatively higher cost. Additionally, Ghana has moderate wind speed, especially along the coast which could be exploited for wind power generation. The current exploitable potential is well over 1,000 MW which could generate over 1,500 Gwh/per year to supplement the nation's energy supply.

Government is committed to improving the cost-effectiveness of solar and wind technologies by addressing the technological difficulties, institutional barriers, as well as market constraints that hamper the deployment of solar and wind technologies.

Furthermore, Ghana has about 18.3 Mha representing three quarters of land area under tree cover. The climatic and soil conditions are very suitable not only for large scale production of agricultural products, but also energy crops and sustainable woodfuel production.

Ghana has recently enacted the enabling legislation "to provide for the utilisation, sustainability and adequate supply of renewable energy for electricity and heat generation and for related matters". One of its main objectives is to increase the share of renewable energy in the energy mix in line with national policy, which sets target share of 10% in 2020. The current share of renewable energy in the energy mix is 0.13% (2010), mainly derived from solar PV and co-generation plants of oil palm and wood processing mills. The Renewable Energy Act, 2011 (Act 832), provides the enabling legal framework for Government to institute a licensing regime for renewable energy producers, a feed-in tariff scheme feed into electricity and a renewable energy development fund.

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. Furthermore, through the Renewable Energy Act 832 (2011), 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.

Another component of biomass that the Government seeks to focus on is liquid biomass fuels. Its policy direction is to balance bio-fuel development against food security, support the development of an indigenous alternative transportation fuel industry based on bio-energy resources namely bio-fuels, and support private sector investments in the cultivation of bio-fuel feedstock. The extraction of the bio-oil and refining of bio-oil into secondary products is also to be supported by legislation.

In order to improve the cost-effectiveness of solar and wind technologies, legislation is required to regulate the fiscal regimes for this and to create the enabling conditions to encourage

investment in renewable energy for on-grid and off-grid electricity generation. With the appropriate legal framework in place, support may be given to indigenous research and development to reduce the cost of solar and wind energy technologies and the use of on-grid and decentralised off-grid alternative technologies like solar and wind, where they are competitive with the conventional electricity supply. In the same vein, the policy direction regarding mini hydro is to create the appropriate fiscal and regulatory framework and provide pricing incentives for mini hydropower projects.

3.1.3. Doubling Improvements in Energy Efficiency

Ghana has been implementing an Appliance Efficiency Programme since 2005, commencing with developing standards on air-conditioners and CFL lamps. In recent years, Ghana has also developed standards on refrigerators and freezers, following the successful implementation CFL replacement project by Government during the energy crisis of 2006. Similar projects are planned for electric fans and other household appliances that have energy-saving potential.

The main challenges with respect to the SE4ALL goal of doubling improvements in energy efficiency are:

- Weak collection and management of data on appliances with energy-saving potential;
- Lack of comprehensive long-term public education;
- Lack of appliance standards and regulations (e.g. on televisions, electric fans etc.); and
- Poor regulation of imports of second-hand machinery, equipment and household appliances.

3.1.4 Cross-Cutting Issues

The main cross cutting issues concerning the SE4ALL goal relate to gaps in the following:

- incentives for private sector financing and investment;
- institutional capacity;
- harmonization of statistical data and research;
- adhoc public education campaigns;
- national recognition for energy awareness and performance (e.g. Green Awards);
- standards; and
- climate change abatement and adaptation.

4. BOTTLENECK ANALYSIS

Following consultations with SEAAF Multi-Stakeholder Consultative Group, Ghana has prioritized the interventions it seeks to pursue to address the objectives of SE4ALL, and has decided to develop the Country Action Plan on Sustainable Energy for All in two Phases. The first phase of the Country Action Plan (covered by this report) deals with interventions to promote Productive Uses of Energy and Modern Energy for Cooking. This Country Action Plan will be amended to include interventions to promote Renewable Energy and Energy Efficiency in addition. The prioritization of the interventions was guided by the following factors:

- Ghana is already pursuing successful programmes to achieve universal access to electricity by 2020;
- Legal instruments have been developed and public education is on-going to promote the use of energy-efficient refrigerators, air conditioners and fluorescent lamps; and
- The Renewable Energy Act has just been passed to enhance the increase of the share of renewable energy in the national energy mix.

The progress and accomplishments of the National Electrification Scheme (NES) will be reviewed and the current action plan of NES will be revised, if necessary, to ensure that the country achieves the 2020 universal access targets. The Energy Commission is also currently updating the Strategic National Plan which was developed in 2006, to review the strategic interventions to increase the share of renewable energy and to intensify efforts to promote energy efficiency.

Within this context, the bottleneck analysis, the prioritization of solutions for accelerating progress towards SE4ALL Ghana in this report focuses on access to modern energy for cooking (LPG and improved cookstoves) and promotion of productive uses of energy.

The main prioritized bottlenecks in the implementation of Ghana's Sustainable Energy for All Acceleration Framework (SEAAF) relate to weaknesses in the following areas:

i. Market-based intervention strategy;
ii. Policy, regulation and standards;
iii. Supply chain infrastructure;
iv. Access for finance, including investment capital and consumer credit;
v. Public awareness, education and outreach;
vi. Consumer capacity building;
vii. Consumer research and statistics; and
viii. Partnership coordination and knowledge management.

These bottlenecks are common to Ghana's main focus areas of intervention – Productive Use of Energy and Modern Energy for Cooking.

4.1 BOTTLENECKS ON PROMOTION OF PUE

As previously mentioned, the level of economic transformation that was expected to have resulted from electrification of districts and communities is yet to be realized at the projected levels. It appears that some rural communities face affordability challenges regarding the electricity extended to them and this continues to plague efforts at getting households and productive users to translate the access to electricity into improved livelihoods and economic development.

The main prioritized action areas to address identified bottlenecks limiting the development and implementation of programmes to promote productive use of electricity as part of energy access initiatives are:

- **Poor design of PUE programmes:** The design of the programmes are often not based on proper feasibility and planning; clear definition of objectives and scope; the context of on-going MSME programmes; and assessment of capacity of implementing partners.

- **Inadequate analysis and design of intervention strategy:** Some intervention strategies are not developed through a comprehensive analysis of the local economy and potentials for productive uses of electricity; taking stock of economic activities in target area, and identifying those which could be upgraded through electricity use; the selection of partner institutions and the determination of the capacity development interventions that will ensure the sustainability of productive use.

- **Weak participation of energy service providers:** There is generally low awareness of productive uses among energy service providers, thus constraining the encouragement of energy service providers to act as technology facilitators.

- **Inadequate technical assistance to MSMEs:** There is poor collaboration between project implementing agencies and other stakeholders to assess and provide the technical training and business development needs of the target group of MSMEs.

- **Poor access to financing:** The awareness and interest amongst micro finance institutions at headquarters and branch levels on financing PUE projects remain low; there is lack of measures to improve access to loans for productive use investments and partnerships with financial institutions to facilitate access to credit are also lacking.

- **Poor monitoring and evaluation:** There has been poor monitoring and evaluation (M&E) of the PUE projects to define results chain, collect baseline data, assess impacts, as well as feed M&E results and lessons learned into further planning.

4.2 BOTTLENECKS ON PROMOTION OF MODERN ENERGY FOR COOKING

4.2.1 LPG Promotion Bottlenecks

There are a number of issues which have been identified as key barriers and challenges that must be addressed if the target of 50% access to LPG by households by 2015 is to be achieved. The key constraint is the chronic LPG shortages that have plagued the country in recent years. These shortages have been caused by frequent refinery closures resulting in insufficient and unreliable supply of LPG to the market, combined with supply constraints associated with inadequate pump/line capacities, inadequate number of loading ramps for bulk road vehicles and insufficient storage capacity. The chronic shortages have been heightened by vehicles using LPG leading to a dramatic increase in LPG consumption. There are also issues with perceived risk of using LPG in homes, high cost of LPG cookers, high discrete costs associated with LPG as compared to charcoal (even though charcoal is more expensive on an energy basis), and inadequate bulk storage capacity for LPG around the country especially in regional and district centres.

The bottlenecks to the promotion of LPG for cooking may be summarized as follows:

- Inadequate supply of LPG to meet the increasing demand;
- Inadequate storage, filling and distribution infrastructure, with over concentration of distribution outlets in regional capitals and major urban settlements, especially in Southern Ghana;
- Inefficient LPG distribution model (i.e. mode of delivery of LPG to consumers) outmoded, inefficient and inequitable;
- Inefficient LPG cylinder management and lack of standards on LPG cookers and cylinders, causing serious safety concerns on quality of LPG cookers and cylinders;
- Unsustainable and inequitable LPG subsidy policy for cooking, which is prone to abuse; and
- Limited awareness, education and outreach to existing and potential consumers (on benefits and safety)

It is quite clear from the foregoing that most of the interventions identified in the Government's National Energy Policy and the Ministry of Energy's 2010 Energy Sector Strategy and Development Plan are still valid and a more concerted effort will have to be made with a greater sense of urgency. Concerns about vehicular use of LPG contributing to shortages should no longer be an issue with adequate supply of LPG from the Gas Processing Facility expected to be operational by the beginning of 2013; what remains an issue in the case of vehicular usage of LPG is the diversion of subsidies which were meant to encourage households to shift away from unsustainable woodfuels.

The Energy Commission's draft LPG Policy paper (May, 2012) proposes measures for consideration by the Ministry of Energy and to be implemented in order to accelerate access to LPG. They are summarized below:

Increase LPG Supply.

- Increase significantly the domestic supply of LPG fuel, by bringing on line new domestic refinery capacity of potentially 300,000 tpa of LPG, to put an end to ongoing LPG fuel shortages.

Build Infrastructure.

- Build substantial new storage, filling and distribution infrastructure commensurate with the increased supply. One additional benefit contemplated by having increased storage capacity is the ability to store buffer inventory of LPG, to mitigate refinery shut-downs that interrupt LPG production.

Introduce New Distribution Model

- Introduce a new distribution model (the "cylinder recirculation" model) into areas with low LPG use, while operating the existing distribution model (the "consumer-owned cylinder" model) in areas where household LPG use is already relatively high. The strategy contemplates providing exclusive concessions to LPG marketers as one form of incentive for them to invest in, and to distribute in, the new market areas.

Develop safety and regulatory standards

- This should cover LPG distribution, LPG cookers, and cylinders.

Create supportive fiscal and other policies

- This includes revising fuel subsidy schemes (and other fiscal schemes) so that they encourage more household use of LPG and minimize undue diversion of LPG (and LPG subsidy benefits) to other sectors, such as commercial and transportation. The strategy contemplates that increased supply will allow parallel, unimpeded growth of LPG consumption in all three sectors—consumer, commercial and transport.

4.2.2 Improved Cookstoves Promotion Bottlenecks

The key challenges that have limited acceleration of access to improved cookstoves in Ghana include:

Policy, Regulation and Standardization

- Lack of national policy, strategy and coordination framework for the cookstoves sector;
- Weak regulation in the cooking sector, including regulation of the charcoal and woodfuel supply chain;
- Lack of incentives to promote the cookstoves sector – e.g. import duties and taxes on technologies and regulation of raw material inputs (scrap metal);
- Poor quality of stoves, mainly relying on artisanal production with lack of technical standards and quality control; and
- Inadequate testing and monitoring mechanisms resulting in poor performance and low durability.

Consumer Awareness, Education and Outreach

- Need to address gender, cultural and behavioural dimensions of cooking;
- Supply-driven promotional projects which lack consumer research and input from end users; and
- Lack of continuous end-user engagement in design and development of improved cookstoves.

Access to Finance

- Limited budget support and over-reliance on pilot projects with short-term funding;
- Limited involvement of banks in formulation and implementation of cookstove programmes;
- Lack of access to finance for producers to improve production capacity, quality, and decentralize production and distribution of cookstoves. Limited access for end users to finance for upfront costs; and
- Lack of funding for research and development, demonstrations, M&E and impact analysis.

Market and Business Dynamics

- Low economies of scale and high cost of the improved cookstoves compared to the traditional cookstoves;
- Inadequate attention to long-term marketing and sustainable value-chain development;
- Inadequate capacity for key actors across the improved cookstove value chain, including researchers, financiers, raw material suppliers, manufacturers and distributors;
- Limited variety of improved cookstoves to support local needs and varied consumer segments;
- Limited technology transfer and diffusion technical knowhow in improved cookstove manufacturing;
- Limited access to raw materials both in terms of quantity and quality; and
- Limited support to strengthen and expand and decentralize local manufacturing of improved cookstoves.

Knowledge Management

- Limited access of key actors in cookstove value chain to current studies, data, best practices and lessons learned;
- Limited statistics, mapping and evidence-based research on household cooking and heating, including local economic, gender and cultural dimensions; and
- Lack of common platforms, e.g. local networks, seminars, workshops, exhibitions for key actors to continuously engage and share information on lessons and successes.

Table 4.1 provides a summary of bottlenecks to key priority Modern Energy for Cooking Interventions to achieve SE4ALL.

Table 4.1: Summary of Bottlenecks to Key Priority Interventions on Productive Use of Energy / Modern Energy for Cooking to achieve SE4ALL

Priority Intervention Area(s)	Prioritized Bottleneck	Bottleneck Category
Promotion of Productive Use of Energy (PUE)	PUE 1.1 Design feasibility and implementation capacity issues (including incomplete data, inadequate assessment of capacity gaps of MSMEs and PUE service providers, and poor mapping of existing projects, overlaps, implementation synergies and lessons)	PUE 1. Programme/Project Design and Feasibility
	PUE 1.2. Local economy analysis and intervention strategy design issues (including stock taking of local economic activities, analysis of PUE opportunities to promote and selection of local implementation partners)	PUE 1. Programme/Project Design and Feasibility
	PUE 2.1. Inadequate awareness creation of PUE issues and strategies amongst local energy service providers	PUE 2. Awareness Creation
	PUE 3.1. Inadequate awareness creation amongst local financial institutions to define measures to improve access to finance, including micro-finance, for PUE ventures/investments	PUE 3. Access to Finance
	PUE 4.1 Inadequate technical assistance for beneficiary MSMEs (including low level of training and business development services in most districts)	PUE 4. Technical Assistance to MSMEs
	PUE 5.1. Inadequate monitoring and evaluation (including incomplete baseline data and research to define results chain, indicators, targets and assess impacts)	PUE 5. Monitoring and Evaluation
Access to Modern Energy for Cooking – Liquefied Petroleum Gas (LPG)	LPG 1.1 Inadequate supply of LPG to meet the increasing demand	LPG 1. Inadequate Supply
	LPG 2.1 Inadequate storage, filling and distribution infrastructure, with over concentration of distribution outlets in regional capitals and major urban settlements, especially in Southern Ghana	LPG 2. Inadequate Infrastructure
	LPG 3.1 Current LPG distribution model (i.e. mode of delivery of LPG to consumers) outmoded, inefficient and inequitable.	LPG 3. Outmoded Distribution Model
	LPG 3.2. Inefficient LPG cylinder management and serious safety concerns on quality of LPG cylinders	
	LPG 4.1. LPG subsidy policy for cooking unsustainable, not equitable, and prone to abuse	LPG 4. Policy and Strategy
	LPG 5.1. Limited awareness, education and outreach to existing and potential consumers (on benefits and safety)	LPG 5. Consumer Awareness, Education and Outreach
Access to Modern Energy for Cooking – Improved Cook Stoves (ICS)	ICS 1.1. Lack of national policy, strategy, coordination and partnership framework for improved cookstoves sub-sector	ICS 1. Policy, Regulation and Standards
	ICS 1.2. Weak regulation of the cooking subsector, including regulation of the charcoal and woodfuel supply chain	
	ICS 1.3. Lack of incentives to promote the cookstoves subsector – e.g. import duties and taxes on technologies and regulation of raw material inputs (scrap metal)	

	ICS 1.4. Poor quality of stoves, mainly relying on artisanal production with lack of technical standards and quality control	
	ICS 1.5. Inadequate testing and monitoring mechanisms resulting in poor performance and low durability	
	ICS 2.1. Poor design of promotional messages that address gender, cultural and behavioural dimensions of cooking	ICS 2. Consumer Awareness, Education and Outreach
	ICS 2.2. Supply-driven promotional projects which lack consumer research and input from end users	
	ICS 2.3. Lack of continuous end-user engagement in design and development of improved cookstoves	
	ICS 3.1. Limited budget support and over-reliance on pilot projects with short-term funding	ICS 3. Access to Finance
	ICS 3.2. Limited involvement of banks in formulation and implementation of cookstove programmes	
	ICS 3.3. Lack of access to finance for producers to improve production capacity, quality, and decentralize production and distribution of cookstoves. Limited access for end users to finance for upfront costs	
	ICS 3.4. Lack of funding for research and development, demonstrations, M&E and impact analysis	
	ICS 4.1. Low economies of scale and high cost of the improved cookstoves compared to the traditional cookstoves.	ICS 4. Market and Business Dynamics
	ICS 4.2. Inadequate attention to long-term marketing and sustainable value-chain development	
	ICS 4.3. Inadequate capacity for key actors across the improved cookstove value chain, including researchers, financiers, raw material suppliers, manufacturers and distributors	
	ICS 4.4. Limited variety of improved cookstoves to support local needs and varied consumer segments	
	ICS 4.5. Limited technology transfer and diffusion technical knowhow in improved cookstove manufacturing	
	ICS 4.6. Limited access to raw materials both in terms of quantity and quality	
	ICS 4.7. Limited support to strengthen and expand and decentralize local manufacturing of improved cookstoves	
	ICS 5.1. Limited access of key actors in cookstove value chain to current studies	ICS 5. Knowledge Management and Technology Transfer
	ICS 5.2. Limited statistics, mapping and evidence-based research on household cooking and heating, including local economic, gender and cultural dimensions	
	ICS 5.3. Inadequate common platforms (e.g. local networks, seminars, workshops, exhibitions) for key actors to continuously engage and share information on lessons and successes	

5. ACCELERATING SE4ALL PROGRESS – IDENTIFYING SOLUTIONS

To address the prioritized bottlenecks identified in Chapter 4, cost-effective solutions in the three areas – Productive Use of Energy, Modern Energy for Cooking (LPG) and Modern Energy for Cooking (Improved Cookstoves) - were proposed, based on potential impact (magnitude, speed and sustainability) and feasibility (governance, capacity and funding availability) to drive progress in Sustainable Energy Access Acceleration towards 2030. These are defined in Table 5.1.

Table 5.1: Prioritized Solutions for Accelerating Progress towards Sustainable Energy for All in Ghana

Priority SE4ALL Goals	SE4ALL Indicators of Progress	Priority Intervention Area	Prioritized Bottleneck	Prioritized Acceleration Solution	Potential Partners
Ensuring Universal Access to Modern Energy Services by 2030	Increase in access to modern energy by households, commercial enterprises, industry and institutions	**Promotion of Productive Use of Energy (PUE)**	PUE 1.1 Design feasibility and implementation capacity issues (including incomplete data, inadequate assessment of capacity gaps of MSMEs and PUE service providers, and poor mapping of existing projects, overlaps, implementation synergies and lessons)	Ensure PUE programme design is feasible, with clear objectives and prioritized interventions that take account of and leverage existing MSME programmes; and assess capacity of implementing partners.	MOEn, EC, ECG, VRA, NEDCO, GRIDCO, Private Sector, DP
			PUE 1.2. Local economy analysis and intervention strategy design issues (including stock taking of local economic activities, analysis of PUE opportunities to promote and selection of local implementation partners)	Analyse local economy and potentials for productive uses of electricity; take stock of economic activities in target area, and identify those which could be upgraded through electricity use; select partner institutions and determine what capacity development interventions will ensure the sustainability of productive use	MOEn, EC, Private Sector, NGO, CBOs
			PUE 2.1. Inadequate awareness creation of PUE issues and strategies amongst local energy service providers	Raise awareness of PUE programmes among energy service providers; and encouraging energy service providers to act as facilitators.	MOEn, EC, Private Sector, NGO, CBOs
			PUE 3.1. Inadequate awareness creation amongst local financial institutions to define measures to improve access to finance, including micro-finance, for PUE ventures/investments	Raising awareness amongst micro finance institutions at headquarters and branch levels; define measures to improve access to loans for productive use investments; and establish partnerships with financial institutions to facilitate access to credit	MOEn, EC, Private Sector, Financial Institutions, NGO, CBOs

			PUE 4.1 Inadequate technical assistance for beneficiary MSMEs (including low level of training and business development services in most districts)	Provide technical training and business development to meet the needs of target MSMEs involved in PUE programmes	MOEn, EC, Private Sector, Financial
			PUE 5.1. Inadequate monitoring and evaluation (including incomplete baseline data and research to define results chain, indicators, targets and assess impacts)	Include relevant energy access and utilization data requirements in Ghana Living Standards Survey (GLSS) data collection instruments	EC, GSS, CSIR
	Increase in % of households using LPG as main cooking fuel	**Access to Modern Energy for Cooking**	LPG 1.1 Inadequate supply of LPG to meet the increasing demand	Ensure that public funded projects underway to improve supply of LPG from Tema Oil Refinery and imports are completed	MOEn, EC,NPA, Private Sector, Financial Institutions,
				Attract private investors to establish large LPG bottle refilling plants(one close to the Gas Processing Plant, one in Tema and eventually one each in Kumasi and Tamale), that are able to test, certify and refill LPG cylinders for the market.	MOEn, EC,NPA,GGS, Private Sector, Financial Institutions,
				Recapitalize GCMC or assist other cylinder manufacturers to manufacture smaller, portable and user-friendly cylinders (5kg and below), and provide these (about 500,000 cylinders per year) at a subsidized cost (using the current LPG subsidy) to LPG distribution franchise operators	MOEn, EC, GCMC. Private Sector, Financial Institutions
				Provide effective leadership in policy and consumer studies, harmonization of indicators and data collection by establishing Energy Access Data Taskforce	EC, Private Sector,

			LPG 1.2. Serious safety concerns on quality of LPG cylinders	Develop, monitor and enforce standards for improving safety	EC, NPA, GSA
				Public education to address perception of high risk of LPG use for cooking in households	EC, NPA, NGOs, CBOs
			LPG 2.1 Inadequate storage, filling and distribution infrastructure, with over concentration of distribution outlets in regional capitals and major urban settlements, especially in Southern Ghana	Offer incentives to encourage private LPG retail/service companies to build up distribution network and retail outlets and re-introduce door to door marketing and distribution of filled LPG cylinders	MOEn, EC, Private Sector, Financial Institutions
			LPG 3.1 Current LPG distribution model (i.e. mode of delivery of LPG to consumers) outmoded, inefficient and inequitable.	Create LPG distribution concessions for existing LPG retailers/marketing companies or new actors; and use the LPG bottle recirculation model in serving the communities that currently do not have LPG filling stations or have low LPG penetration rates	NPA
				Establish favourable and transparent product pricing regime for LPG, including favourable bulk transportation margins, and a bulk storage pricing regime that would recover costs and allow for competitive rates of return on investment.	MOEn, EC, NPA, Private Sector,
			LPG 4.1. LPG subsidy policy for cooking unsustainable, not equitable, and prone to abuse	Redirect the current subsidy away from LPG fuel to domestic LPG equipment/appliances to make it possible to retarget the subsidy at domestic users, encouraging more of them to move away from unsustainable woodfuels for cooking, and to address the problem of unintended subsidy leakage to vehicle users	MOEn, EC, NPA, Private Sector,

	% households using improved cookstoves increases	**Access to Modern Energy for Cooking**	ICS 1.1. Lack of national policy, strategy, coordination and partnership framework for improved cookstoves subsector	Establish inter-institutional framework for coordinating policy research, regulations, standards, partnership development, programme design and resource mobilization for clean energy cooking sector; institute domestic policy for clean cookstove and advance legislation for promotion and development of the clean cookstove sector; and introduce advanced biomass cookstoves for cooking in public institutions, hotels and restaurants	MOEn, EC, NPA, GSA, Private Sector,
	Urban household woodfuel use intensity reduced		ICS 1.2. Weak regulation of the cooking subsector, including regulation of the charcoal and woodfuel supply chain		MOEn, EC, NPA, GSA, Private Sector,
	Rural household firewood use intensity reduced				
	Improved cookstoves use in hotels, restaurants, institutional kitchens increased		ICS 1.3. Lack of incentives to promote the cookstoves subsector – e.g. import duties and taxes on technologies and regulation of raw material inputs (scrap metal)		MOEn, EC, NPA, GSA, Private Sector,
			ICS 1.4. Poor quality of stoves, mainly relying on artisanal production with lack of technical standards and quality control		MOEn, EC, NPA, GSA, Private Sector,
			ICS 1.5. Inadequate testing and monitoring mechanisms resulting in poor performance and low durability		MOEn, EC, NPA, GSA, Private Sector,
			ICS 2.1. Poor design of promotional messages that address gender, cultural and behavioural dimensions of cooking	Partner with women's groups and NGOs to reach the end users; invest in training trainers and community-level promoters; and leverage other sectors and infrastructure, such as health and immunization clinics, to promote benefits	MOEn, EC, NPA, Women Groups, NGOs, CBOs
			ICS 2.2. Supply-driven promotional projects which lack consumer research and input from end users	Undertake consumer surveys and regional energy needs assessment to map socio-cultural variations and priorities	MOEn, EC, NPA, Women Groups, NGOs, CBOs

			ICS 2.3. Lack of continuous end-user engagement in design and development of improved cookstoves	Engage end users in product design and marketing and promotional campaigns and messages; and address roles of men and women as producers, purchasers, and consumers of the solutions	MOEn, EC, NPA, Women Groups, NGOs, CBOs
			ICS 3.1. Limited budget support and over-reliance on pilot projects with short-term funding	Increase budget support for the clean cooking subsector	MOEn, EC, NPA, NGOs, CBOs, DPs
			ICS 3.2. Limited involvement of banks in formulation and implementation of cookstove programmes	Establish inter-institutional framework for coordinating policy research, regulations, standards, partnership development, programme design and resource mobilization for clean energy cooking sector; institute domestic policy for clean cookstove and advance legislation for promotion and development of the clean cookstove sector	MOEn, EC, NPA, Women Groups, Private Sector, NGOs, CBOs
			ICS 3.3. Lack of access to finance for producers to improve production capacity, quality, and decentralize production and distribution of cookstoves; Limited access for end users to finance for upfront costs	Fully engage with financial sector in the design and implementation of cookstove programmes to provide medium to long-term finance (5-10yrs) for capital investments in production and business growth	MOEn, EC, NPA, Financial Institutions,, Private Sector, NGOs, CBOs
			ICS 3.4. Lack of funding for research and development, demonstrations, M&E and impact analysis	Set up funding for research and development, demonstrations, M&E, and impact analysis – support local institutions; Finance baseline studies and capacity building to leverage carbon financing	MOEn, EC, NPA, Financial Institutions,, Private Sector, NGOs, CBOs
			ICS 4.1. Low economies of scale and high cost of the improved cookstoves compared to the traditional cookstoves.		MOEn, EC, NPA, Financial Institutions,, Private Sector, NGOs, CBOs

			ICS 4.2. Inadequate attention to long-term marketing and sustainable value-chain development	Promote knowledge and experience sharing among stakeholders; provide capacity building support and training on various technologies	MOEn, NPA, EC, Private Sector, Universities, CSIR, DPs
			ICS 4.3. Inadequate capacity of key actors across the improved cookstove value chain, including researchers, financiers, raw material suppliers, manufacturers and distributors to promote cookstove technology innovation and adaptation	Establish repository of 'clean' cookstove technologies along with appraisal data of technologies; sensitize Improved cookstove manufacturers to promote a range of technologies for varied needs; support technology transfer and partnerships with international manufacturers	MOEn, EC, NGOs, CBOs
			ICS 4.4. Limited variety of improved cookstoves to support local needs and varied consumer segments		
			ICS 4.5. Limited technology transfer and diffusion of technical knowhow in improved cookstove manufacturing		
			ICS 4.6. Limited access to raw materials both in terms of quantity and quality	Institute and enforce comprehensive biomass policies and regulations	MOEn, NPA, EC
			ICS 4.7. Limited support to strengthen and expand and decentralize local manufacturing of improved cookstoves	Encourage practitioners to participate in collaborative forums, update data and results, and share with others in the sector; Undertake comparative studies to map the sector in the regions and gather evidence on use and best practices; and support demonstrations, exhibitions, seminars, workshops, etc. for knowledge sharing	MOEn, NPA, EC, Women Groups, NGOs, CBOs

6. SE4ALL ACCELERATION PLAN – GHANA COUNTRY ACTION PLAN

Ghana's Country Action Plan for Sustainable Energy for All Acceleration is primarily on advancing the cause of universal access to modern energy for cooking and for productive use of energy. These have been identified as priority intervention areas, where accelerated removal of critical bottlenecks are likely to yield the highest and most widespread impacts on people's living conditions and economic livelihoods, particularly in underserved rural and peri-urban communities and households.

In line with the objective of UNDP's Sustainable Energy for All Acceleration Framework (SEAAF), the technical preparation highlighted progress made, strengths as well as many constraints for interactive consultations with energy sector stakeholders to identify the most binding constraints (most crippling bottlenecks). This has helped in collectively devising specific solutions and prioritized actions to accelerate the achievement in Ghana of positive outcomes towards "Sustainable Energy for All" by 2030, which are outlined in detail in this Country Action Plan in Table 6.1. Table 6.2 also presents the Country Action Plan Implementation and Monitoring Plan. The cost of prioritized interventions under the Plan are estimates, and in each instance, comprehensive feasibility studies need to be conducted to confirm the viability of the intervention.

International partnerships will be sought to enhance the successful implementation of the interventions, taking advantage of knowledge sharing on proven technologies as well as best practices in the rollout of sustainable energy interventions. Notable among these potential partnerships relate to the Global Alliance for Clean Cookstoves, the Global LPG Partnership and the Africa Clean Cooking Initiative.

Table 6.1: Country Action Plan towards Sustainable Energy for All in Ghana

Prioritized Interventions	Priority Bottleneck	Prioritized Acceleration Solution	Potential Partners	Total Cost US$
Access to Modern Energy for Productive Uses	PUE 1.1 Design, feasibility and implementation capacity issues (including incomplete data, inadequate assessment of capacity gaps of MSMEs and PUE service providers, and poor mapping of existing projects, overlaps, implementation synergies and lessons) PUE 1.2. Local economy analysis and intervention strategy design issues (including stock taking of local economic activities, analysis of PUE opportunities to promote and selection of local implementation partners) PUE 2.1. Inadequate awareness creation of PUE issues and strategies amongst local energy service providers PUE 3.1. Inadequate awareness creation amongst local financial institutions to define measures to improve access to finance, including micro-finance, for PUE ventures/investments	**PUE in irrigation** 1..Irrigation on River Banks with Electricity *Conduct feasibility study and implement total of 5,000 ha small-scale irrigation schemes on the banks of the White and Black Volta rivers in Northern, Upper East and Upper West Regions* *Train local artisans for installation and maintenance of equipment* *Educate and sensitise beneficiary farmers* 2. Irrigation on River Banks with Wind Pumps *Conduct feasibility study and install 2000 Poldaw windpumps to irrigate 4000 hectares of farmlands in Central, Greater-Accra and Volta Regions* *Train local artisans for installation and maintenance of windpumps* *Educate and sensitise beneficiary farmers on Poldaw windpumps* 3. Mini-hyro dams for electricity and irrigation *Conduct feasibility study and establish 3x5 MW mini-hydro plants / irrigation infrastructure for 1000 ha each on Black Volta, White Volta, Oti River, Tano River, and Pra River* *Train local artisans for installation and maintenance of equipment* *Educate and sensitise beneficiary farmers*	GIDA, MOFA, MOEn, Farmer Cooperatives, CWSA, MMDAs GIDA, MOFA, MOEn, Farmer Cooperatives, CWSA, MMDAs GIDA, MOFA, MOEn, Farmer Cooperatives, CWSA, MMDAs	50,000,000 70,000,000 110,000,000

	PUE 4.1 Inadequate technical assistance for beneficiary MSMEs (including low level of training and business development services in most districts)	**PUE in Agro-processing** 1. Produce drying *Establish 100,000 X 1,000kg natural convection solar dryers for cassava, maize and vegetables for small-farmer cooperatives in the 10 Regions* *Train local artisans for installation and maintenance of equipment* *Educate and sensitise beneficiary farmers* 2. Palm oil production *Conduct feasibility study and establish 5000 small-scale oil palm processing plants in palm oil producing areas in Central, Western, Volta, Eastern and Ashanti Regions* *Train local artisans for installation and maintenance of equipment* *Train women groups* *Educate and sensitise beneficiary SMEs* 3. Multifunctional platforms (MFP) for grinding and milling *Conduct feasibility study and establish 2000 MFPs with cassava graters, double screw presses, grinding mills, rice hullers in Brong Ahafo and Northern Regions* *Train local artisans for installation and maintenance of equipment* *Train women groups* *Educate and sensitise beneficiary SMEs*	MOFA, MOEn, MOWAC, Farmer Cooperatives, Women Groups, MMDAs MOFA, MOEn, MOWAC, Farmer Cooperatives, Women Groups, MMDAs MOFA, MOEn, MOWAC, Farmer Cooperatives, Women Groups, MMDAs	50,000,000 75,000,000 70,000,000
		PUE in Fisheries 1. Fisheries Landing Sites and Coldstores *Conduct feasibility study and construct modern landing sites and provision of cold stores and refrigeration facilities at 5 sites in the Western, Central and Greater-Accra Regions, and inland sites on banks of Volta Lake*	MOFA, MOEn, DOF,GNCFC, NFAG, GIFA, Rural Banks, NGOs, CBOs, DAs	50,000,000

		Train local artisans for installation and maintenance of equipment *Train women groups* *Educate and sensitise beneficiary SMEs* 2. Aquaculture *Conduct feasibility study and establish 50 aquaculture ventures in the Northern, Brong-Ahafo, Ashanti and Volta Regions* *Train women groups* *Educate and sensitise beneficiary SMEs*	MOFA, MOEn, MOWAC, Rural Banks, NGOs, CBOs, Women Groups, DAs	50,000,000
		Other PUE Activities 1. PUE in Salt Production *Conduct feasibility study and establish 10 medium-scale salt production ventures in the Greater Accra and Volta Regions* *Train women groups* *Educate and sensitise beneficiary SMEs* 2. PUE using biogas *Conduct feasibility and establish institutional biogas systems for 200 boarding schools, hospitals and prisons* *Train local artisans for installation and maintenance of equipment* *Educate and sensitise beneficiary institutions*	MOTI, MOWAC, MOEn, REP, NBSSI, Rural Banks, DAs MOEn, EC, Private Sector, Financial MOEn, EC, MOE, MOI, MOH, NGOs, CBOs, Rural Banks	10,000,000 50,000,000
		Sub-total		**585,000,000**

Access to Modern Energy for Cooking - LPG	LPG 1.1 Inadequate supply of LPG to meet the increasing demand	Public funded projects underway to improve supply of LPG from Tema Oil Refinery and imports are completed	MOEn, EC,NPA, GGC, Private Sector, Financial Institutions	
	LPG 1.2. Serious safety concerns on quality of LPG cylinders	Establish 4 x 100TMTPA LPG bottle refilling plants that are able to test, certify and refill LPG cylinders for the market.at • near Gas Processing Plant • Tema • Kumasi • Tamale	MOEn, NPA, GGC, Private Sector, Financial Institutions	100,000,000
	LPG 2.1 Inadequate storage, filling and distribution infrastructure, with over concentration of distribution outlets in regional capitals and major urban settlements, especially in Southern Ghana	Recapitalize GCMC and assist other cylinder manufacturers to manufacture smaller, portable and user-friendly cylinders (5kg and below)	MOEn, NPA, GCMC, GGC, Private Sector, Financial Institutions	25,000,000
	LPG 3.1. LPG subsidy policy for cooking unsustainable, not equitable, and prone to abuse	Provide 500,000 cylinders per year for five years at a subsidized cost (using the current LPG subsidy) to LPG distribution franchise operators	MOEn, NPA, GCMC, GGC, Private Sector, Financial Institutions	50,000,000
		Develop, monitor and enforce standards for improving safety	MOEn, EC, GSA	500,000
		Establish PPP with LPG retailers/marketing companies to build up distribution network and retail outlets; and re-introduce door-to-door marketing and distribution of filled LPG cylinders	MOEn, NPA, Private Sector, Financial Institutions	50,000,000
			Sub-total	**225,500,000**

Access to Modern Energy for Cooking – Improved Cookstoves	ICS 1.1. Lack of national policy, strategy, coordination and partnership framework for improved cookstoves sub-sector	Develop policy and legislation for promotion and development of the clean cookstove sector	MOEn, EC, MOWAC, GSA, Women Groups, Private Sector	1,000,000
	ICS 1.2. Weak regulation the cooking subsector, including regulation of the charcoal and woodfuel supply chain	Pilot advanced biomass cookstoves for cooking in public institutions, hotels and restaurants with private sector	MOEn, EC, Women Groups, Private Sector, Financial Institutions	2,000,000
	ICS 1.3. Lack of incentives to promote the cookstoves subsector – e.g. import duties and taxes on technologies and regulation of raw material inputs (scrap metal)	Undertake consumer surveys and regional energy needs assessment to map socio-cultural variations and priorities	MOEn, EC, MOWAC, Women Groups, NGOs, CBOs	2,000,000
	ICS 1.4 Poor quality of stoves, mainly relying on artisanal production with lack of technical standards and quality control	Engage end users in product design and marketing and promotional campaigns and messages; and address roles of men and women as producers, purchasers, and consumers of the solutions	MOEn, EC, MOWAC, Women Groups, NGOs, CBOs	2,000,000
	ICS 1.5. Inadequate testing and monitoring mechanisms resulting in poor performance and low durability	Implement programs to sensitise and provide technical assistance to rural and peri-urban communities to develop sustainable biomass resources through community woodlots	MOEn, EC, MOWAC, Financial Institutions,, Private Sector, NGOs, CBOs	5,000,000
		Increase budget support for the clean cooking sector	MOEn, EC	
	ICS 2.1. Poor design promotional messages that address gender, cultural and behavioural dimensions of cooking	Establish inter-institutional framework for mobilizing investment financing in the private sector, in collaboration with financial institutions	MOEn, EC, MOWAC, Financial Institutions,, Private Sector, NGOs, CBOs	1,000,000
	ICS 2.2. Supply-driven promotional projects which lack consumer research and input from end users	Set up and operate funding to support local institutions for research and development, demonstrations, M&E, and impact analysis; Finance baseline studies and capacity building to leverage carbon financing	MOEn, EC, MOWAC, Financial Institutions,, Private Sector, NGOs, CBOs	8,000,000
	ICS 2.3. Lack of continuous end-user engagement in design and development of improved cookstoves			

	ICS 3.1. Limited budget support and over-reliance on pilot projects with short-term funding	Establish website as repository of 'clean' cookstove technologies and designs, and update regularly	MOEn, EC, CSIR, Financial Institutions,, Private Sector, NGOs, CBOs	200,000
	ICS 3.2. Limited involvement of banks in formulation and implementation of cookstove programmes	Institute annual forum (including demonstrations and exhibitions) for improved cookstoves practitioners, end-users, policy makers and financial institutions to assess progress in cookstoves subsector	MOEn, EC, Private Sector, Universities, CSIR, DPs	500,000
	ICS 3.3. Lack of access to finance for producers to improve production capacity, quality, and decentralize production and distribution of cookstoves; Limited access for end users to finance for upfront costs			
	ICS 3.4. Lack of funding for research and development, demonstrations, M&E and impact analysis			
	ICS 4.1. Low economies of scale and high cost of the improved cookstoves compared to the traditional cookstoves.			
	ICS 4.2. Inadequate attention to long-term marketing and sustainable value-chain development			
	ICS 4.3. Inadequate capacity of key actors across the improved cookstove value chain, including researchers, financiers, raw material suppliers, manufacturers and distributors to promote cookstove technology innovation and adaptation			

	ICS 4.4. Limited variety of improved cookstoves to support local needs and varied consumer segments			
	ICS 4.5. Limited technology transfer and diffusion technical knowhow in improved cookstove manufacturing			
	ICS 4.6. Limited support to strengthen and expand and decentralize local manufacturing of improved cookstoves			
		Sub-total		**21,700,000**
Cross-cutting Issues	CCI 1.1 Gaps in data and research (including consumer research) and lack of funding for regular annual surveys to update date	Conduct Annual Energy Access and Consumer Research surveys	EC, MOEn, GSS, NGOs, CBOs	7,000,000
	CCI 2.1 Lack of funding for sustained public education and awareness creation	Prepare and implement Annual Programmes for Public Education and Awareness Creation	EC, MOEn, NGOs, CBOs	15,000,000
	CCI 3.1 Lack of Standards and weak regulatory regimes	Develop Standards for enhanced devices and strengthen regulations	EC, GSA,CSIR, MEST, Universities	3,000,000
	CCI 4.1 Low level of mainstreaming gender into policies and programmes	Mainstream Gender into policies and programmes and evaluate effectiveness	EC, MOEn, MOWAC, Women Groups, NGOs, CBOs	2,000,000
	CCI 5.1 Weak integration of Climate Change into programmes and projects	Integrate Climate Change into programmes and projects and evaluate effectiveness	MEST, EC, EPA,CSIR, Universities	1,000,000
	CCI 6.1 Establish and implement effective national governance and monitoring mechanism for SE4ALL	Organise regular inter-Ministerial and Inter-Agency Meetings to review SE4ALL policies, programmes and projects	EC, MOEn	84,000
		Sub-total		**28,084,000**
		GRAND TOTAL		**860,284,000.00**

Table 6.2: Ghana CAP Implementation and Monitoring Plan

ACCELERATION ACTVITIES	INDICATOR	IMPLEMENTATION TIMELINE (2011-2020; 2025-2030)						
		2012	2013	2014	2015	2020	2025	2030
Access to Modern Energy for Productive Uses								
1. Conduct feasibility study and implement total of 5,000 ha small-scale irrigation schemes on the banks of the White and Black Volta rivers in Northern, Upper East and Upper West Regions	5,000 ha of irrigated land on banks in Northern Ghana							
2. Conduct feasibility study and install 2000 Poldaw windpumps to irrigate 4000 hectares of farmlands in Central, Greater-Accra and Volta Regions	4,000 ha of irrigated farmland							
3. Conduct feasibility study and establish 5 5 MW mini-hydro plants / irrigation infrastructure for 1000 ha each on Black Volta, White Volta, Oti River, Tano River, and Pra River	55 MW mini-hydro plants established							
4. Establish 100,000 X 1,000kg natural convection solar dryers for cassava, maize and vegetables for small-farmer cooperatives in the 10 Regions	1,000 units of solar dryers established in 10 regions							
5. Conduct feasibility study and establish 5000 small-scale oil palm processing plants in palm oil producing areas in Central, Western, Volta, Eastern and Ashanti Regions	5000 small-scale oil palm processing plants commissioned							
6. Conduct feasibility study and establish 2000 MFPs with cassava graters, double screw presses, grinding mills, rice hullers in Brong Ahafo and Northern Regions	2000 Multifunctional Platforms							
7. Conduct feasibility study and construct modern landing sites and provision of cold stores and refrigeration facilities at 5 sites in the Western, Central and Greater-Accra Regions, and inland sites on banks of Volta Lake	Modern landing sites, cold stores, refrigeration facilities							
8. Conduct feasibility study and establish 50 aquaculture ventures in the Northern, Brong-Ahafo, Ashanti and Volta Regions	50 aquaculture ventures established							
9. Conduct feasibility study and establish 10 medium-scale salt production ventures in the Greater Accra and Volta Regions	10 medium-scale salt production ventures established							
10. Conduct feasibility and establish institutional biogas systems for 200 boarding schools, hospitals and prisons	200 boarding schools, hospitals and prisons establish institutional biogas systems							

Access to Modern Energy for Cooking - LPG								
11. Ensure that public funded projects underway to improve supply of LPG from Tema Oil Refinery and imports are completed	Projects to improve supply of LPG from Tema Oil Refinery and imports completed							
12. Establish 4 x 100TMTPA LPG bottle refilling plants that are able to test, certify and refill LPG cylinders for the market.at • near Gas Processing Plant • Tema • Kumasi • Tamale	Four 100TMTPA LPG bottle refilling plants established							
13. Recapitalize GCMC or assist other cylinder manufacturers to manufacture smaller, portable and user-friendly cylinders (5kg and below), and provide these (about 500,000 cylinders per year) at a subsidized cost (using the current LPG subsidy) to LPG distribution franchise operators	500,000 cylinders (5kg and below) manufactured locally per year							
14. Develop, monitor and enforce standards for improving safety	Safety Standards developed							
15. Establish PPP with LPG retailers/marketing companies to build up distribution network and retail outlets; and re-introduce door-to-door marketing and distribution of filled LPG cylinders	Number of LPG distribution network and retail outlets doubled							
16. Provide subsidy on domestic LPG equipment/ appliances by redirecting current subsidy on LPG fuel	Subsidy redirected							
Access to Modern Energy for Cooking – Improved Cookstoves								
17. Develop policy and legislation for promotion and development of the clean cookstove sector	Policy approved by cabinet & Legislation enacted							
18. Pilot advanced biomass cookstoves for cooking in public institutions, hotels and restaurants with private sector	Uptake of advanced biomass cookstoves by 1000 institutions							
19. Undertake consumer surveys and regional energy needs assessment to map socio-cultural variations and priorities	Consumer survey findings published							
20. Engage end users in product design and marketing and promotional campaigns and messages; and address roles of men and women as producers, purchasers, and consumers of the solutions	Promotional campaigns messages disseminated to producers, purchasers, and consumers							

21. Increase budget support for the clean cooking sector	Budget support for clean cooking sector doubled							
22. Implement programs to sensitise and provide technical assistance to rural and peri-urban communities to develop sustainable biomass resources through community woodlots	Community woodlots established in 3000 communities							
23. Establish inter-institutional framework for mobilizing investment financing in the private sector, in collaboration with financial institutions	inter-institutional framework established and operational							
24. Set up and operate funding to support local institutions for research and development, demonstrations, M&E, and impact analysis; Finance baseline studies and capacity building to leverage carbon financing	Fund established and operational							
25. Establish website as repository of 'clean' cookstove technologies and designs, and update regularly	Website developed and populated							
26. Institute annual forum (including demonstrations and exhibitions) for improved cookstoves practitioners, end-users, policy makers and financial institutions to assess progress in cookstoves subsector	Annual stakeholders forum held							
Cross-cutting Issues								
1. Conduct Annual Energy Access and Consumer Research surveys (AECRS)	AECRS conducted annually							
2. Prepare and implement Annual Programmes for Public Education and Awareness Creation (APPEDAC)	APPEDAC implemented							
3. Develop Standards for enhanced devices and strengthen regulations	Standards developed							
4. Mainstream Gender into policies and programmes and evaluate effectiveness	Gender Mainstreaming evaluated							
5. Integrate Climate Change (CC) into programmes and projects and evaluate effectiveness	Integration of CC evaluated							
6. Organise regular inter-Ministerial and Inter-Agency Meetings (IMIAM) to review SE4ALL policies, programmes and projects	IMIAMs organised							

7. IMPLEMENTATION ARRANGEMENTS (OVERSIGHT, COORDINATION AND MANAGEMENT OF SE4ALL COUNTRY ACTION PLAN)

Effective implementation of the Ghana SE4ALL Country Action Plan requires governance arrangements that reflect cross-sectoral cooperation and inter-ministerial coordination. This will ensure that at the policy level, acceleration of sustainable access to energy as an imperative for sustainable growth, employment and poverty reduction remains a major plank of national strategies for shared growth.

At the programme level, the mobilization and facilitation of the private sector participation, e.g. through investment partnerships, will be critical to the success of the County Action Plan. SMEs can drive productive uses of energy as well as sustainable penetration of energy services and devices into underserved peri-urban and rural markets. However it will take the support of the financial sector to develop relevant and innovative credit products to raise the long-term capital needed. District Assemblies and community-based civil society organizations, are prime agents of change at the local level.

The planned institutional arrangements elaborated below therefore reflect the above functional areas of need.

7.1 ANNUAL NATIONAL SE4ALL FORUM

A National Forum on Sustainable Energy for All will be convened every year by the Ministry of Energy to review progress on the implementation of the Ghana Country Action Plan. It will serve the SE4ALL “Annual General Meeting” of all stakeholders (government, the private sector, civil society, research community and end-user representatives) and a forum for holding those responsible for implementing the Country Action Plan to account. Presentation of the overall CAP Monitoring and Performance Assessment Report will be the centre piece of the National Forum, enabling stakeholders to review progress against the targets set. It will also serve as the principal forum for private sector partnership and investment promotion.

7.2 INTER-MINISTERIAL COMMITTEE

An Inter-Ministerial Committee, chaired by the Ministry of Energy, will also be constituted to provide strategic oversight and governance over the implementation of the Country Action Plan. This will comprise of the Ministry of Energy, Ministry of Trade and Industry, Ministry of Agriculture, Ministry of Environment, Science and Technology, Ministry of Local Government and Rural Development and the Ministry of Women and Children’s Affairs. This Committee, will establish Project Steering Committees as its sub-committees, and co-opt representatives of civil society, research community and the private sector, especially business associations and financial institutions, as members.

The Inter-Ministerial Committee will meet bi-annually to set overall policy and take responsibility for deploying resources to their most productive use across the various project components outlined in the CAP. On the other hand, the Project Steering Committees will as act as trustees of additional SE4ALL funds mobilized and pooled to fill in the public funding gap. Principal among the sub-committees will the Productive Use of Energy Sub-Committee, the LPG Sub-Committee and the Improved Cookstoves Sub-committee, reflecting the three prioritized areas of Ghana's pro-poor, pro-jobs SE4ALL Country Action Plan.

7.3 THE SECRETARIAT

The Energy Commission will serve as the Secretariat for the coordination and management of the Country Action Plan. As the management team, the Secretariat will be ultimately responsible and accountable for managing the implementation of Country Action Plan. This will require the designation of a National SE4ALL Coordinator within the Energy Commission to serve as the lead programme manager of the Country Action Plan.

The Coordinator will firstly exercise executive stewardship of the Country Action Plan resources in general and advise the Project Sub-Committees where the best opportunities for delivering the SE4ALL outcomes are and how the required investments can be made and managed to ensure maximum returns. Secondly, working with project implementation partners identified in the Country Action Plan, the Coordinator will serve as the lead facilitator of the project interventions, providing technical assistance (TA) or TA funding to implementation partners, including for commissioning feasibility studies, consumer and end-user research, work plan preparation and results monitoring. As the Secretariat, Energy Commission will establish the proposed Taskforce of Energy Access Data which will collaborate with the Ghana Statistical Services and other bodies to incorporate sustainable access to energy into regularly collected and updated data.

APPENDIX: MEMBERS OF MULTI-STAKEHOLDER CONSULTATIVE GROUP

1. Board Chairman, Energy Commission – Chairman

Government Agencies

2. Executive Secretary, Energy Commission
3. Chief Executive Officer, National Petroleum Authority
4. Chief Executive Officer, Bulk Oil Storage and Transportation Company
5. Chief Executive Officer, Forestry Commission
6. Director for Renewable Energy, Ministry of Energy
7. Director for Climate Change, Ministry of Environment, Science and Technology
8. Director for Crop Preservation, Ministry of Food and Agriculture
9. Chief Executive Officer, Irrigation Development Authority
10. Director for SME Finance, Ministry of Trade and Industry
11. Chief Executive Officer, National Board for Small Scale Industry
12. Director for Indoor Air Pollution, Ministry of Health
13. Director for Multilateral Finance, Ministry of Finance and Economic Planning
14. Director for Energy, National Development Planning Commission

Private Sector

15. Managing Director, Toyola Company Ltd (Improved Cookstoves Manufacture/Retail)
16. Managing Director, Annaset Co Ltd (LPG Retail)
17. Managing Director, Xpress Gas Ltd (LPG Retail)
18. Managing Director, Fueltrade (LPG Bulk Supply)

NGOs

19. Executive Director, Abantu for Development
20. Director, Kumasi Institute of Technology and Environment
21. Executive Chairman, New Energy
22. Executive Director, Energy Foundation
23. Executive Director, Private Enterprise Foundation

Financial Institutions

24. Manager, Agribusiness and Climate Finance Initiatives, Ecobank Ghana Ltd
25. Manager, Energy, Barclays Bank

Development Partners

26. Project Manager, UNDP
27. Chairman, Energy Sector Working Group

REFERENCES

Ahiataku-Togobo, W.M (2002). "Analysis of Household Cooking Energy in Ghana", Powerpoint presentation at the LP Gas Promotion Workshop, Akosombo, April 15-17.

Centre for Economic Policy Analysis (2002). Energy Intensity Survey of the Modern Sector

Climate Care (2009). Project Note - Ghana, Efficient Cook Stoves

Electricity Company of Ghana (2010). Annual Report and Audited Accounts, 2009

Electricity Company of Ghana (2011). Annual Report and Audited Accounts, 2010

Energica (2009). Pre-feasibility study for an improved cook stoves project in Northern Ghana

Energy Commission (2003). "Woodfuel Use in Ghana: Outlook for the Future"

Energy Commission, 2009. Renewable Energy Framework for Climate Mitigation in Ghana.

Energy Commission (2010). 2011 Energy Outlook

Energy Commission (2011). Annual Report for 2010

Energy Commission (2011b) Survey on Energy Use in Ghana

Energy Commission (2011c). National Energy Statistics (2000 – 2010)

Energy Commission (2011d). Survey on Energy Use in Ghana

European Union (2011). The EU Energy Initiative Partnership Dialogue Facility (EUEI PDF) Annual Report October 2010 – September 2011

Enterprise Works Ghana (2011). EWG Programs in Ghana http://www. ewghana.org/programs/aspx

Ghana Grid Company (2011). Electricity Supply Plan

Ghana Statistical Service (2008) Ghana Living Standards Survey Report of the Fifth Round (GLSS 5)

Humado, C.K. (2011) Concept Paper on the Establishment of the Keta Lagoon Basin Authority

Index Mundi (2012). Ghana Economy
http://www.indexmundi.com/ghana/economy_profile.html

International Energy Agency (2011) Energy for All – Financing Access for the Poor

KITE (2006) Ghana: Sector Reform and the Pattern of the Poor - Energy Use and Supply. Prepared for World Bank, ESMAP

M.A. Trossero, FAO (2002). Unasylva 211, Vol. 53, 2002

Ministry of Energy (2005). Feasibility Studies on Productive Uses of Electricity in the Keta District

Ministry of Energy, 2010. Energy Sector Strategy and Development Plan

Ministry of Energy, 2010a. National Energy Policy

Ministry of Energy (2011) National Electrification Scheme (NES) Master Plan Review (2011-2020) Final

Ministry of Energy (2011b). Ghana: Energy Development and Access Project. Fourth Quarter Report, 2011.

Ministry of Energy (2011c). Renewable Bill

Ministry of Environment, Science and Technology (2009). National Science, Technology and Innovation Policy

Ministry of Food and Agriculture (2007). Food and Agriculture Sector Development Policy

Ministry of Food and Agriculture (2011). National Irrigation Policy, Strategies and Regulatory Measures

Ministry of Health (2006). National Health Policy

Ministry of Trade and Industry (2011). Ghana Industrial Policy

National Development Planning Commission (2010). Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013 Volume I: Policy Framework