GHANA MILLENNIUM CHALLENGE ACCOUNT PROGRAM

# COMPACT II

*Powering Ghana for Accelerated and Sustainable Economic Growth*

# POWER DISTRIBUTION & UTILISATION

# CONCEPT PAPER

**(PROJECTS 2A,2B,4,5A,5B,5C)**

***SUBMITTED TO***
***THE MILLENNIUM CHALLENGE CORPORATION***
***WASHINGTON D.C.***

**Table of Contents**

## List of Figures



## List of Tables

**ABBREVIATIONS**

| | |
|---|---|
| AMR | Automatic Meter Reading |
| ATC&C | Aggregated Technical, Commercial and Collection |
| BSP | Bulk Supply Point |
| ECG | Electricity Company of Ghana |
| Gh¢ | Ghana Cedi |
| GIS | Geographic Information System |
| GOG | Government of Ghana |
| IPP | Independent Power Producer |
| km | kilo meter |
| kV | kilo Volt or 1,000 Volts |
| kVA | kilo Volt Amperes (1,000 Volt Amperes) |
| LI | Legislative Instrument |
| LV | Low Voltage (in Ghana 230V single phase or 400V three phase) |
| MDA | Ministries, Departments and Agencies (Government Institutions) |
| MOE | Ministry of Energy |
| MVA | Mega Volt Ampere or 1,000,000 Volt Ampere |
| MVAr | Mega Volt Ampere Reactive or 1,000,000 Volt Ampere Reactive |
| NEDCo | Northern Electricity Distribution Company |
| NES | National Electrification Scheme |
| PURC | Public Utilities Regulatory Commission |
| RoW | Right of Way |
| SHEP | Self Help Electrification Programme |
| SLT | Special Load Tariff |
| SWS | Shield Wire System |
| V | Volt |
| VRA | Volta River Authority |

# 1 Project Rationale and Description

The 2000 Population and Housing Census shows that about 80 percent of the economically active population work in the informal sector of Ghana, mainly in agricultural, commerce and manufacturing. Within the agricultural sector, women constitute 52 percent of the labor force and contribute 46 per cent to the total agricultural GDP. Yet, they lack the resources needed to enhance their productivity and income (MoFA 2006).

The electricity sector has been identified as constituting a binding constraint to the national economy. Starter problems requiring attention are the low reliability of power supply and insufficient access to electricity. Reliability of electricity supply as a whole is the product of the reliability of each section of the electricity supply chain i.e. generation, transmission and distribution. In addition to reducing overall supply reliability, the distribution sector's unsatisfactory performance makes it more difficult to resolve problems in generation and transmission.

The distribution sector's high system losses and unacceptable collection rates contribute substantially to its unsatisfactory financial performance which in turn reduces the sector's credibility with regard to long term ability to meet its financial obligations. As a result, prospective IPPs are unwilling to invest without government guarantees to back power purchase agreements. Distribution companies are also unable to secure sufficient long term funding and so utilise expensive short term credits for their development projects. This situation leads to a vicious cycle of worsening infrastructure and even poorer performance.

The poor performance and attitude of ECG staff contribute to ECG's unsatisfactory performance which in turn contributes to customer dissatisfaction and reluctance to pay higher tariffs.

The increasing contribution of thermal generation combined with upward pressure on prices of fossil fuels will make it necessary to increase the generation component of the tariff. Furthermore the need to factor reactive power compensation into the tariff will tend to increase the transmission component. The cost and significance of losses at the distribution level will therefore increase.

There is insufficient reactive power compensation at the distribution level and it leads to unnecessarily high technical losses at the transmission and distribution stages. The situation also makes it necessary to use scarce generation capacity to provide necessary reactive power.

Capacity of distribution facilities is often inadequate. This contributes to high technical losses and poor reliability. High technical losses adversely affect financial performance of utilities. Distribution systems often lack redundancy and in some cases may be overloaded. This leads to poor reliability at the distribution level.

The three northern regions have the highest levels of poverty and the lowest rates of access to electricity. The levels of poverty hinder communities in these regions from accessing the Self Help Electrification Project, a component of the National Electrification Scheme.

Several peri-urban communities have networks that do not cover the entire community. Consumption levels and consequently revenue streams from such communities are so low that distribution companies do not have an incentive to maintain or upgrade their networks.

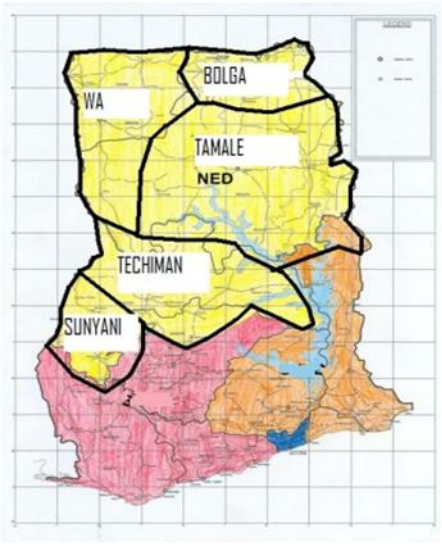


**Figure 1 - Operational areas of ECG and NEDCo**

The persistently high load growth rate has resulted in the need for high levels of investment at all stages of the electricity supply chain.

It is thought that increased reliability of electricity supply and increased access to electricity will improve productivity and profitability of beneficiary businesses. It will also improve the social well-being by enabling facilities such as schools and health facilities to deliver services of higher quality. Lastly these improvements will help increase incomes of inhabitants of beneficiary areas by improving their abilities to undertake income earning activities.

## 1.1 Problem/ Constraint Statement

The Ghanaian public is served by two distribution companies, ECG and NEDCo. ECG operates in the southern sector, its operations cover 36% of Ghana's land area and it distributes about 90% of the public distribution load. NEDCo on the other hand operates in the northern sector, its operations cover 64% of Ghana's land area but it only distributes about 10% of the public distribution load. **Error! Reference source not found.** shows operational areas for the two utilities. NEDCo is responsible for Wa, Bolga, Tamale, Techiman and Sunyani operational districts. ECG is responsible for the rest of Ghana.

### 1.1.1 Electricity Company of Ghana

ECG experienced 10%/ year energy growth rate in 2010 and an average of 5.4%/ year energy growth over the period 2000 to 2010. In 2011, its customer population increased by 10% to 2.4million. Growth in demand was the result of urbanisation, redevelopment of city centres, relatively robust economic growth and new investments mainly in the crude oil and other extractive minerals sector. Access improvement/ rural electrification projects contributed to the high growth rate of customer population.

ECG's system losses increased from 25.75% in 2010 to 29.52% of purchases in 2011[1]. The estimated value of commercial losses in 2010 based on average end user tariff at the time was about US$110million. The upward trend in losses occurred in spite of large investments in metering and network reinforcements. Network investments are thought to have been insufficient for the load growth rates experienced while metering investments addressed supply of meters without adequately tackling other key issues.

Table 1 and Table 2 show loss indicators for ECG as a whole and for Tema Operational Region respectively. In both tables, the largest contributor to aggregated losses appears to be commercial losses followed by collection loss.

[1] Executive Summary ECG, National Technical and Commercial Loss Study 2012 – Global Energy Consulting Engineers.

**Table 1 – Losses in ECG Operational Area**

| Year | Distribution Loss (Tech + Commercial) (%) | Technical Loss (%) | Commercial Loss (%) | Collection Loss (%) | Aggregated Technical, Commercial & Collection Loss (%) |
|---|---|---|---|---|---|
| 2010 | 25.75 | | | | 43.56 |
| 2011 | 29.52 | 10.97 | 18.55 | 13.96 | 43.48 |

**Table 2 – Losses in ECG's Tema Operational Region**[2]

| Year | Distribution Loss (Tech + Commercial) (%) | Technical Loss (%) | Commercial Loss (%) | Collection Efficiency (%) (Collection Loss %) | Aggregated Technical, Commercial & Collection Loss (%) |
|---|---|---|---|---|---|
| 2010 | 26.35 | | | 80.13 (14.63) | 40.98 |
| 2011 | 31.82 | 10.38 | 21.45 | 82.06 (12.23) | 44.05 |

ECG's high commercial loss level and unsatisfactory revenue collection arise out of various issues including:

- Ineffective enforcement of service connection requirements (routing of service tail, meter location etc.)
- Incorrect geographic coding of services
- Non-implementation of systems that minimise tampering of meters and assist in detection of tamper attempts.
- Inaccurate and dysfunctional meters as well as use of inappropriate meters
- Inadequate quality control and assurance in metering, billing and revenue collection
- Ineffective implementation of disconnection procedures
- Delays between application, meter installation and first billing of customers.

[2] Regional Energy Loss Study – Tema, 2012 by Global Energy Consulting Engineers Private Limited, India. Losses are given as percentages of energy purchases

- Delays by GOG in effecting payments for GOG's consumption as well as for subsidies relating to consumption by non-GOG customers. Subsidies include lifeline tariff and general subsidies to avoid tariff increases.
- Inadequate efforts to inspect in order to detect electricity theft
- Lack of systematic energy accounting framework
- "Profitable" nature of electricity theft in that stolen electrical energy is estimated very conservatively based on durations of up to one year typically and is billed at tariff prevailing at time of theft without penalties.

Technical losses arise due to flow of electricity through network components. The recent loss study proposed a technical loss benchmark for ECG of 7.14% as compared with the estimate for 2011 of 10.97% and a maximum tolerable limit of 11.22%.

Technical losses tend to be related to adequacy and effectiveness of capital investment. The more robust a power system is, the lower the levels of technical losses. Where a power system is deprived of needed investment and where there is high incidence of overloading, frequent outages, suppressed demand and poor customer end voltages, technical losses tend to be exceptionally high. Where there is a low level of utilisation of transformer capacity, technical losses also tend to be high.

The average annual investment in the ECG network has been roughly US$100 million over the last four (4) years. ECG estimates that about US$200 million/ year was required to meet investment requirements. The under-investment contributed to deterioration of quality of service in spite of continued investments in ECG.

Tariffs that have generally been below costs combined with high losses and poor revenue collection have contributed to less than desirable financial performance by ECG.

ECG's development has been financed mainly by the World Bank and other development partners based on a mix of loans backed by GOG guarantees and grants. The poor financial health of ECG has limited its ability to raise long term credit to fund capital investment requirements. ECG is therefore compelled to use short term supplier provided credit to fund part of its development. The present approach to use of supplier provided credit is not based on competitive procurement and is considered expensive.

ECG's network is extremely unreliable. Average customer lost hours from 2008 - 2011 is estimated at 155 hours per customer per year. Unfortunately, the trend is consistently upward. Furthermore, power supply at some locations is characterised by unacceptably low voltages, voltage fluctuations, frequent failures and long outage periods. Unreliable and poor quality supply compound ECG's problems by reducing its revenue and increasing its costs. Poor quality power supply also increases commercial losses by adversely affecting billing meters.

Regulations require utilities to meet minimum standards of power quality, reliability and customer services. Customers are obtaining redress with financial compensation for alleged deficiencies in performance by utilities. Poor service delivery has been used by the public to the PURC as a reason to reject applications for tariff increases.

One major challenge ECG faces is the lack of up-to-date network data for network planning and operations, particularly at the 11kV and low voltage levels. Key information such as network route length, construction type and cable routes are not well documented and this makes system planning difficult. ECG has undertaken a number of exercises to collect data on its infrastructure. Unfortunately, records collected were very quickly rendered obsolete due to ineffective update procedures.

ECG does not have records that show where on its network individual customers are supplied from. This makes it impossible to account for energy or to generate dependable reliability statistics in terms of number of customers affected by a particular outage or energy not supplied as a result of an outage.

There are perceptions that tariff increases and investments in infrastructure have not had the desired impact on reliability and that ECG is not responsive to the needs of existing and prospective customers. It is believed that ECG's employees and its internal inefficiencies are partly responsible for its poor service and high commercial and collection losses.

### 1.1.2 Northern Electricity Distribution Company (NEDCo)

The Northern Electricity Distribution Company (NEDCo) is a subsidiary of the Volta River Authority (VRA). Previously, NEDCo's area of operation was served by ECG using diesel generating plants. Responsibility for distribution was transferred to NEDCo,[3] as part of efforts to extend the grid to northern Ghana.

Due to low customer density and low loads that were forecast during planning of the initial extension of the national grid, certain network design criteria were relaxed to make the project economically viable. In addition, some medium voltage circuits were installed using the Shield Wire Scheme (SWS)[4] in order to reduce the initial cost.

Utilisation of the electricity distribution network has increased over the years increasing customer population from less than 20,000 in 1987 to over 380,000 in 2011. However, the network has not seen an appropriate increase in investment. This has led to an increase in losses, poor customer supply voltages and frequent outages. NEDCo is unable to connect applicants in certain areas to the network due to overloads on some distribution transformers.

With extension of NEDCo's network, increase in load and attempts to use electricity for productive purposes, the shield wire scheme's disadvantages are becoming more constraining to NEDCo and its customers. Some disadvantages are listed below.

- Most SWS implementations in NEDCo were single phase schemes and this limits the productive use of electricity because customers are unable to use three phase electrical motors. This has led to several corn mills in the NEDCo area being diesel powered even

[3] NEDCo was previously known as the Northern Electricity Department (NED) of VRA

[4] Shield wire schemes involve the use of insulated wire mounted in place of the sky wire on high voltage (161kV) lines. The insulated wire conveys electricity at medium voltage (34kV) to distribution transformers along or close to the route of the 161kV line.

where operators have access to electricity because nearby electricity network is single phase.

- Conductor sizes are small as compared to conventional lines. Voltages at load ends tend to be low and technical losses are greater than for conventional lines.
- The smaller conductor size limits the power that can be supplied over the SWS.

NEDCo's Tamale network is supplied from a transformer at Tamale Bulk Supply Point (BSP) that provides electricity at both 11kV and 34kV. 34kV supply was initially used for rural lines while 11kV supply was used for Tamale Township. Tamale has grown larger and loading has increased. Peripheral areas of Tamale are still supplied at 11kV from the BSP even though this results in excessive technical losses as well as unacceptably low voltages within the 11kV system. The length of 11kV feeders is leading to unreliability. The present loading pattern on the Tamale BSP transformer is such that total 11kV demand tends to exceed transformer's 11kV capacity even though there is substantial 34kV transformer capacity unused.

As part of technical regulation of the electricity sector, various legislative instruments (LIs) have been passed that introduce minimum requirements for technical performance and customer service for distribution utilities. It is necessary for NEDCo to improve its operations to comply with these regulations.

NEDCo's performance as at the end of 2011 may be as summarised below:

- Technical and Commercial Losses was 20.2%
- Collection rate was 77% with Ministries, Departments and Agencies (MDAs) and 85% without MDAs
- Receivables was Gh¢95 million
- Receivables lag 325days
- Average access to electricity 36 to 44% (2010)
- 34.5kV and 11kV feeder availability was 98%
- Quality of service delivery below acceptable standard
    - Voltages were often below minimum acceptable limit
    - Response times to customer complaints frequently exceeded acceptable limits and
    - Customers were generally not satisfied with NEDCo's service delivery

The impact of the above performance is that

- Businesses are less willing to invest in northern Ghana partly because of poor power quality and limited access to electricity
- Socio-economic development is negatively affected

- Health facilities do not have reliable power to refrigerate drugs and so are limited to providing basic services
- Schools do not have reliable power for Information and Communication Technology (ICT) utilisation etc.

- Ghana Government's initiative to accelerate the development of the northern sector is hampered by unacceptable power quality.
- Some developed areas within electrified communities do not have electricity thus preventing small businesses from operating.

Table 3 and Table 4 show loss indicators for NEDCo as a whole and for Tamale Operational Region respectively. In both tables, the largest contributor to aggregated losses appears to be collection loss.

**Table 3 – Losses for NEDCo Operational Area**[5]

| Year | Distribution Loss (Tech + Commercial) (%) | Technical Loss (%) | Commercial Loss (%) | Collection Loss (%) | Aggregated Technical, Commercial & Collection Loss (%) |
|---|---|---|---|---|---|
| 2010 | 19.58 | | | | 36.37 |
| 2011 | 20.24 | 10.62 | 9.62 | 18.67 | 38.91 |

**Table 4 – Losses for NEDCo Tamale Operational Area**[6]

| Year | Distribution Loss (Tech + Commercial) (%) | Technical Loss (%) | Commercial Loss (%) | Collection Efficiency (%) (Collection Loss %) | Aggregated Technical, Commercial & Collection Loss (%) |
|---|---|---|---|---|---|
| 2010 | 18.42 | | | 69.53 (24.86) | 43.28 |
| 2011 | 19.12 | 9.53 | 9.58 | 58.54 (33.53) | 52.65 |

[5] Executive Summary – NEDCo, National Technical and Commercial Loss Study 2012 – Global Energy Consulting Engineers

[6] Region Wise Energy Loss Study and Segregation of Technical and Commercial Losses, NEDCO, 2012 by Global Energy Consulting Engineers Private Limited, India

### 1.1.3 Intensification of Peri-Urban Networks

Under the Self Help Electrification Program (SHEP), communities are sometimes only able to procure low voltage poles to cover parts of the communities and so outlying portions of communities are left out of electrification projects. Even where communities were initially adequately covered by electrification schemes, they develop over time until there are sizable developments beyond electrified areas. In some instances further development of communities has resulted in overloading of low voltage networks.

Consumption levels and consequent revenue streams from rural and peri-urban electrified communities tend to be low. The low per-capita consumption also implies a low average end user tariff received by utilities. A large proportion of customers is eligible for government subsidies and this means that utilities' collection efficiency is significantly influenced by timing of payments by GOG. Utilities often prefer to invest in urban areas than in rural and peri-urban communities partly due to the lower financial returns on rural and peri-urban investments. The tendency then is for rural and peri-urban communities to have poor power quality or, for sections of these communities, to lack access to electricity without any hope of interventions by the distribution companies.

### 1.1.4 Access to Electricity – Off Grid Renewable Energy

The Ministry of Energy estimates that there are about 200 island communities with populations of about 350 which are not likely to be connected to the national grid in the foreseeable future due to high connection costs. Some lakeside and island communities lost portions of their lands as a result of the creation of the Volta Lake. In addition to these communities, there are communities that are either small or sparsely populated or far from the national grid. It will not be economically feasible to connect such communities to the national grid.

Lack of electricity is a barrier to development. It prevents occupants of some communities from making use of facilities such as cell phones and increases the cost of using television sets (used in distance education in schools). Lack of access to electricity means that health facilities may not be able to store some drugs and vaccines or provide good care at night. Lack of electricity is a major reason for the reluctance of public workers (teachers, health workers) to accept postings to such areas.

Currently, the contribution of renewable energy in the total national electricity generation mix is less than 0.1%.

### 1.1.5 Increased Access for Productive Use of Electricity

Markets in Ghana face problems of low capacity networks that result in occupants receiving poor quality electricity and suffering frequent outages. Markets generally have inadequate public lighting and are limited to operating within periods with good sun lighting. Poor public lighting means that users of markets, mainly female, are at increased risk at dawn and dusk.

Markets often experience fire outbreaks that are largely attributed to electrical faults. Fire outbreaks are generally extremely destructive because of difficulty in ensuring that electricity supplies to affected areas are disconnected in a timely manner so that fire crews can fight fires. The destructive nature of fire outbreaks in markets results in significant financial loss to occupants.

Processing of food by low income households tends to be labour intensive due to inability to purchase appliances. Very few commercial food vendors own appliances suitable for preparation of ingredients. Some enterprises at markets and vantage locations provide a mechanised food preparation exercise that covers processes including grinding, milling and mixing. Most service providers operate a single appliance through which food items pass during processing. It is necessary to work on different food items and this results in inconveniences to users, contamination and sanitation risks.

A significant proportion of economic activity in Ghana is due to operations of small and micro enterprises. There are several situations in which these enterprises develop and operate in clusters. The pioneer occupants of an area may have had planning permission and may originally have had adequate access to electricity. However, as the user population increases, demand for electricity increases. Frequently, expansion of infrastructure does not keep pace with demand and the power quality deteriorates. A number of clusters currently experience unacceptably poor quality of electricity supply. Their low voltage distribution networks tend to be overloaded and excessively long. As a result such areas experience frequent outages and unacceptably low voltages. Occupants of such areas are sometimes unable to operate and suffer damage to equipment and appliances. The poor quality and layout of low voltage networks results in high levels of technical and commercial losses.

### 1.1.6 Demand Side Management

The most current load forecast for the Ghana system points to annual demand growth of 6.1% - 6.4% over the period 2011 – 2021. This persistently high load growth poses a major challenge in terms of the need for upgrades to generation, transmission and distribution infrastructure. In the past two decades, increases in demand for electricity have outpaced increases in supply.

Even while efforts are made to add capacity to all stages of the electricity supply chain, it is necessary to reduce the rate of growth of demand for electricity in a cost effective manner. This may be done through electricity conservation and improvement in efficiency of use.

Ghana's electricity demand peak is between 6pm and 10pm. This peak is influenced significantly by the residential load. Commercial and industrial loads also contribute to system peak. If some customers transfer electricity use from peak hours then system peak would be reduced. This may be done through time of use tariffs or through interruptible tariffs. The PURC is interested in investigating tariffs to reduce system peaks and to flatten demand profiles. It however is yet to undertake the studies required to determine how best to go about this approach.

The opportunities to shift residential loads in Ghana are rather limited. The most feasible approach to reduction in contribution to system maximum demand by residential loads appears to be through efficiency improvements. Ultimately, it is likely that time of use and interruptible tariffs will be most effective for commercial and industrial customers. Until such time that PURC has sufficient data to introduce tariffs to encourage load shifting, the most important opportunities for demand side management appears to be from improvements in efficiency of use of electricity.

Ghana has previously implemented demand side management (DSM) programs as a way of limiting demand for electricity. One successful program involved replacement of incandescent lamps with fluorescent lamps (compact fluorescent lamps or CFLs). A ban on importation of incandescent lamps

is being enforced. In view of the fact that lighting is the most basic and widespread use of electricity, it is necessary to ensure that lamps and lighting fixtures meet minimum efficiency standards.

A major source of waste of electrical energy is through use of inefficient refrigeration and air conditioning equipment. A ban on the importation of used refrigeration appliances is due to come into force in 2013. However, even after the ban comes into force, there will still be a large number of inefficient refrigeration appliances in use.

The Energy Commission is about to start a project that seeks to improve the energy efficiency of refrigeration appliances used in Ghana. Activities will include the introduction of energy efficiency standards for refrigeration appliances in Ghana and demonstration of replicable and scalable equipment turn-in and replacement program that removes inefficient and environmentally damaging appliances from the market and replaces them with more efficient and environmentally friendly models. Motors constitute a large electrical load in industry and residences. It is therefore necessary all motors, whether standalone and in equipment, be required to comply with minimum efficiency standards.

A major obstacle to purchase of energy efficient appliances is the lack of understanding of the financial implications of use of inefficient appliances. Previously, prospective buyers had less of an incentive to purchase efficient appliances in Ghana due to relatively low cost of electricity, high interest rates and lack of credit. However, the trend for electricity prices is upwards while interest rates have been progressively reduced. Credit is more available now than in the past. It is therefore important for prospective buyers to understand the influence of efficiency of appliances on the cost owning and using appliances.

Adoption of energy efficiency practices by the energy consuming public has been constrained by inadequate knowledge and awareness by the public on the proper and efficient operation of common household appliances like refrigerators and freezers, electric irons, fans, air-conditioners, lighting and water heaters.

Local industries need to enhance their competitiveness in order to survive. One way of doing this is to reduce their operating costs and improved energy efficiency is one way of achieving this.

Large, well run industries and commercial organisations are a potential source of energy savings. Such institutions have the corporate desire to undertake worthwhile energy saving initiatives as a means of improving their profitability. These institutions may however lack the expertise to undertake, in a structured manner, analysis of energy consumption to come up with energy efficiency initiatives.

Energy efficiency in industry is relatively low in most small and medium size factories. This is due to a combination of factors including operating machines below rated capacity, the use of old inefficient technologies and lack of capacity to implement energy efficiency measures. Smaller firms lack knowledge, internally, to systematically identify opportunities for improvements in energy efficiency and to make the business case for such improvements.

Poor power factor at distribution level results in unnecessarily high losses in distribution and transmission. Poor power factor also causes generation capacity to be used up to provide reactive power. There are about 1000 customers in Ghana billed on Special Load Tariff (SLT). These

customers are responsible for more than 30% of electrical energy consumed. Poor power factor of SLT customers worsens power factor in networks that supply these loads. This requires distribution companies to invest substantially in power factor correction. In 2011 about 260 SLT customers had average power factors that were below 0.8[7]. SLT tariffs incorporate separate charges for energy and maximum demand (kVA). SLT tariffs also impose a surcharge when the customer's average power factor for the month is below a threshold, currently 0.9. SLT customers with poor power factor therefore pay unnecessarily high maximum demand charges and power factor surcharges. The payback period for power factor correction by SLT customers is of the order of 1year when the initial power factor is 0.8 and the final power factor is 0.95. It is believed that the main barriers to power factor correction by SLT customers are lack of interest due to small amounts of money involved, lack of knowledge and insufficient credit.

## 1.2 Desired Long Term Sector Objectives

The vision for the electricity sector is to develop an "Energy Economy" that will ensure secure and reliable supply of high quality energy services for all sectors for the Ghanaian economy. It is also intended for Ghana to become a net exporter of power by 2015.[8]

Activities proposed under this Concept Paper will directly help achieve energy sector objectives listed below:

- Reduce technical and commercial losses in power supply;
- Support the modernisation and expansion of energy infrastructure to meet growing demands and ensure reliability;
- Improve access to modern forms of energy;
- Improve the overall management, regulatory environment and operation of the energy sector;
- Minimise the environmental impacts of energy supply and consumption through increased production and use of renewable energy and make energy delivery efficient;
- Ensure cost recovery for energy supply and delivery;
- Ensure the productive and efficient use of energy and
- Promote and encourage private sector participation in the energy sector.

[7] Based on analysis of billing data provided by ECG
[8] National Energy Policy, Ministry of Energy, February 2010

**Table 5 – Relationship between Sector Objectives and Proposed Activities**

| Sector Objectives | Proposed Activities |
|---|---|
| Reduce technical losses in power supply. | Reactive power compensation; Activities under reinforcement of distribution networks; Demand Side Management (power factor campaign); GIS based Distribution Management System, Technical Assistance |
| Reduce commercial losses in power supply. | Replacement of existing meters with prepayment meters; Re-routing of concealed service tails; Institutional Support (Energy Loss Control Centre; GIS based Distribution Management System; Customer Care Centre; Loss Control Unit; Technical Assistance) |
| Support the modernisation and expansion of energy infrastructure to meet growing demands and ensure reliability. | Activities under reinforcement of distribution networks; Distribution Automation; Institutional Support (Technical Assistance, GIS based Distribution Management System) |
| Improve access to modern forms of energy. | Access improvement (Off grid renewable energy); Intensification of peri-urban networks; Access improvement for productive use of electricity |
| Improve the overall management, regulatory environment and operation of the energy sector. | Institutional Support (Technical Assistance) |
| Minimise the environmental impacts of energy supply and consumption through increased production and use of renewable energy and make energy delivery efficient. | Access improvement (Off grid renewable energy); Reactive Power Compensation; Demand Side Management |
| Ensure cost recovery for energy supply and delivery. | Replacement of credit meters with prepayment meters; Re-routing of concealed service tails; Energy Loss Control Centre; GIS based Distribution Management System; Loss Control Unit |
| Ensure the productive and efficient use of energy and | Access improvement for productive use of electricity |
| Promote and encourage private sector participation in the energy sector | Replacement of credit meters with prepayment meters |

## 1.3 Expected Project Outcomes

The most important outcomes from Institutional Support activities are substantial improvements in business culture and staff attitude in the demonstration areas of Tema and Tamale. This component is expected to help organisations operate more efficiently and become more responsive to customer needs.

Activities such as the Energy Loss Control Centre, GIS based Distribution Management System, Customer Care Centre and Loss Control Unit provide a framework for systematic reduction of losses. These activities also assist utilities to improve the quality of service experienced by customers. Reduced losses will contribute to increased profitability of utilities. Improved customer satisfaction is expected to increase customer willingness to pay.

Improved planning and operational information from proposed GIS based Distribution Management Systems will enable utilities come up with projects that are better targeted and more effective and in so doing help improve utilities' operational efficiencies.

Major outcomes from proposed loss reduction activities are reduced system losses, mainly commercial, and improved revenue collection. Reduced losses and improved revenue collection will contribute to improved financial position of the distribution utilities. Improved financial positions of distribution companies will improve their access to long term financing and this in turn will help increase the rate of investment to further reinforce and extend networks.

Distribution reinforcement activities are expected to increase capacity of networks, reduce technical losses slightly and directly contribute to improvements in reliability and power quality. These will lead to increased revenues and slightly reduced costs which will further improve financial performance of distribution utilities.

Improved financial performance of distribution companies, if sustained, will in the long term contribute to reduce the need for GOG or third party guarantees to back power purchase agreements with prospective IPPs. This situation ought to improve rate of implementation of generation facilities which will in turn improve reliability at generation level. Improved financial performance should eventually improve access of distribution companies to long term funding for their development needs.

Access improvement through intensification will provide beneficiaries with access to electricity. Intensification activities will in some instances improve reliability and quality of supply.

The main outcome from increased access to electricity for productive uses will be improved productivity of women and men as well as improved delivery of social services. It is also expected that occupants of beneficiary markets will experience reduced loss of property due to fewer outbreaks of fire. Markets are also expected to benefit from improved security as a result of better public lighting. Finally, economic activity is expected to increase at markets provided with public lighting. Access to electricity by schools and health facilities is expected to help them provide better quality services. Utilities are expected to experience reduced losses as result of network improvements and rationalisation of service connections.

The main outcome from demand side management activities will be increased efficiency in use of electricity. Increased efficiency will either reduce the rate of load growth or it will make energy available for productive uses. Power factor improvement campaigns are expected to lead to reduced technical losses and reduced use of generation capacity for production of reactive power. Average power factor for participating customers is expected to increase and their cost of electricity bills is expected to reduce.

Improved reliability and increased access to electricity are expected to lead to greater productivity and reduced cost of production of enterprises, establishment of productive ventures and increased employment. It is anticipated social facilities e.g. markets, health care facilities, schools etc. will be better able to provide services.

## 1.4 Description of Project Outputs and Specific Activities

### 1.4.1 Distribution – ECG (Project 2A)

#### 1.4.1.1 Institutional Support

This component will supplement initiatives proposed for ECG under the "Strengthened Sector Corporate Governance and Regulatory Capacity" Section of the "Increasing Private Sector Investment through Power Sector Reform" concept paper. Institutional Support will focus on improving performance at the regional level.

Institutional support activities are proposed because it is recognised that provision of distribution infrastructure alone will not result in a fundamental or sustained change in ECG's performance. It is accepted that there also need to be increased management accountability and better decision support information combined with changes in procedures as well as attitude, performance and supervision of employees.

##### *1.4.1.1.1 Technical Assistance for Tema Operational Region*

It is proposed to improve the performance of Tema Operational Region in areas of technical and commercial operations by providing technical assistance. It is intended that this activity will make the region more responsive to the needs of stakeholders. The details of technical assistance have not yet been determined. However, it is anticipated that this activity will include a mix of diagnostic studies followed by remedial processes, attachment of staff from advanced utilities and development of new business procedures. An important aspect of this activity will be to assist in the reinforcement of staff discipline. The project will advocate among others for qualified females in management positions. The following areas are proposed as part of technical assistance to Tema:

a) Counterpart Staff – It is proposed that staff from advanced utilities be twinned with key personnel in Tema Region. Such persons will act as agents of change as well as assist, guide and mentor ECG staff during transition to a well operated unit. They will also assist to make operational the various improvements proposed for Tema. Suggested positions include General Manager, Regional Engineer, Commercial Manager, IT Manager, and Human Resource Manager.

b) Reengineering of business processes – It is necessary to reengineer business processes to achieve aggressive loss reduction, improve revenue processes and provide good quality service to customers. It will also be necessary to ensure that the GIS is maintained and the GIS based Distribution Management System is fully utilised. Areas of concern include network construction, network operations, maintenance, fault location and customer management. An element of reengineering will be reinforcement of quality systems.

c) Staff Reorientation – ECG staff are reputed to have a poor attitude to their customers and in some cases to their responsibilities. It is essential that staff attitude be changed by training combined with enforcement of ECG's Code of Conduct.

d) Staff Training – It is proposed to upgrade the capacity of staff through training in a number of key areas utilising funds from the Compact. The training programs will involve all categories of staff at Tema Operational Region as well as those staff who provide services to/ or interact with Tema Operational Region. Training will cover new business procedures introduced in Tema as well as general skills training where deficiencies are identified.

e) Loss Reduction - Consultancy and Training – This component is specifically required to support the systematic reduction of losses as well as the setup and operation of the ELCC and GIS based Distribution Management System.

#### *1.4.1.1.2 Energy Loss Control Centre (ELCC)*

It is proposed to establish an Energy Loss Control Centre (ELCC) to receive and analyse data from AMR meters and use the information primarily for loss reduction and also for network planning, operations and fault location. The ELCC will analyse data to provide energy information such as purchases, sales and loss indicators at regional and district level. It will also estimate technical losses.

The ELCC will be responsible for managing the Loss Control Unit (LCU). It will use data from meters to alert the LCU of tamper attempts. It will also identify areas of high losses in order to prioritise such areas for investigation by loss control units. The ELCC will analyse customer (SLTs and the larger non-SLTs) consumption patterns to identify abnormal patterns for investigation by loss control units. As part of its responsibility for loss control, the ELCC will monitor performance of the LCU. It will also track ECG's performance with respect to prosecutions relating to power theft.

The ELCC will identify outages at the distribution level using data from network and customer metering and inform fault correction units. The ELCC will also be responsible for generating reliability indicators at regional and district level.

The ELCC will be responsible for power supply monitoring to generate load curves and to estimate parameters such as load factor, loss factor and maximum demand. Information will be useful in network planning and design to help ensure that power quality is acceptable.

The ELCC will provide summary information to ECG management and other stakeholders.

The ELCC allows systematic reduction of losses and more efficient network planning. It will help to improve the reliability of networks.

#### *1.4.1.1.3 Geographic Information System (GIS) based Distribution Management System*

It is proposed to implement a GIS based Distribution Management System (GDMS) for networks (33kV, 11kV and low voltage) and customer related information within Tema Operational Region. GDMS is essential to a systematic loss reduction effort because it provides the means to undertake energy accounting and to determine losses by feeder and transformer.[9]

Implementation of the GDMS will involve the following activities

- Provision of IT and related infrastructure
- Global Positioning System (GPS) based mapping of networks at 33kV, 11kV and LV levels
- Enumeration and GPS based mapping of customers
- Linking of GIS with customer information database

It is important that the GIS is kept up to date so it shows the current status of networks and customers at any time. In order to achieve this, it is essential that business procedures be changed so that the GIS is at the heart of network construction, operation and maintenance. It is also necessary for the GIS to be central to customer management. Without satisfactory changes to business procedures, there will be no point in attempting to set up a GDMS because it will not be possible to maintain the GIS and customer indexing.[10]

The following enterprise processes will be built onto the GIS and automated

a. Network planning and design
b. New customer management
c. Asset management, including asset maintenance system and asset outage systems
d. Fault detection, fault isolation and power supply restoration

The GDMS centre will also collocated with ELCC to ensure that all the facilities like WAN & LAN, stand by power supply, 24x7 operations are shared.

The main benefit of the proposed GDMS is the ability to link spatial information with technical and load data to in a manner that will enable ECG to make informed decisions. This benefit is expected to result in effective loss reduction programs, more cost effective network improvement schemes, better quality of supply and more reliable statistics.

[9] National Technical and Commercial Loss Study Executive Summary for ECG – Global Energy Consulting Engineers, 2012

[10] National Technical and Commercial Loss Study Executive Summary for ECG – Global Energy Consulting Engineers, 2012

#### *1.4.1.1.4 Customer Care Centre*

It is proposed to establish a Customer Care Centre (CCC) to ensure satisfactory response to all customer inquiries, applications for service and complaints including faults. CCC will operate round the clock. It will be staffed by operators who will receive all regional customer requests by telephone, short message service (sms) and email.

All calls will be numbered and stamped with time and date. They will be monitored until issue is resolved satisfactorily. Customers will be able to track progress on complaints over the internet or by telephone follow-up. Supervisors will receive reports based on elapsed time since report etc. to identify situations of delayed resolution.

Operators will be supported by GIS based distribution management system.

#### *1.4.1.1.5 Loss Control Unit*

It is proposed to improve the regional loss control unit to become a more effective deterrent to electricity theft. This activity will focus on providing equipment, training and improved procedures. This activity will be complemented by improved staffing, application of sanctions to culpable ECG staff and vigorous legal prosecution. The overall intention is to increase the proportion of services and meters inspected and to improve effectiveness of performance.

The main benefit of the enhanced Loss Control Unit is reduction in commercial losses by detecting causes of commercial losses and discouraging theft of electricity.

### 1.4.1.2 Reduction in System Losses and Improvement of Revenue Collection Rates

#### *1.4.1.2.1 Technical Loss Reduction*

##### 1.4.1.2.1.1 Reactive power compensation

It is proposed to install 70.2MVAr of shunt capacitors at 11kV bus bars of primary substations and along 11kV feeders.

The aim is to reduce reactive power flow in 33kV and 11kV networks and reduce technical losses. It will also free up capacity for transmission of power along 33kV and 11kV circuits. Generation plant and 161kV transmission network will experience slightly reduced loading and losses.

This activity will improve voltage profiles especially along relatively long 11kV feeders. The alternative to reactive power compensation will be to upgrade feeders and transformers and this alternative is generally more expensive.

#### 1.4.1.2.1.2 Reinforcement of Distribution Networks

Activities proposed under Reinforcement of Distribution Networks under Section 1.4.1.3 will directly reduce technical losses as a side benefit. Activities are summarised below and are discussed in greater detail in section 1.4.1.3.

- Construction of bulk supply point at Afienya and construction of 33kV network to connect bulk supply point to 33kV network – Activity reduce loading of existing bulk supply station and 33kV networks. Activity will also reduce lengths of 33kV networks.
- Construction of Primary (33/11kV) substations at Community 2 and Trade Fair and associated 33kV and 11kV circuits – Activity will reduce loading and length of 11kV circuits.
- Construction of 33kV and 11kV feeders – Activity will reduce loading of feeders
- Low voltage network improvement – Activity will reduce loading and length of LV networks.

### *1.4.1.2.2 Commercial Loss Reduction*

#### 1.4.1.2.2.1 Replacement of Meters

It is proposed to install 445,000 split type prepayment meters with automatic meter reading (AMR) capability and associated vending stations and master stations. Meters are mainly intended to replace approximately 276,000 existing meters and to service prospective customers estimated at 10% growth per year. Some meters will be used to regularise illegal connections.

The new meters are expected to be more accurate (lower losses) than meters (including electromechanical) that they will replace. Specification of meters will be such as to make ineffective some of the current methods of meter tampering. Meters will also be capable of detecting unauthorised attempts to open meter case or terminal cover.

Measuring components of split meters will be mounted on facia boards where service wire first makes contact with customers' building. This feature will make ineffective any bypasses within customers' premises.

Automatic meter reading (AMR) capability will enable meters to communicate key information such as consumption and tamper attempts to a reception point. Analysis of this information will contribute to dependable energy accounting and will act as a deterrent to some forms of energy theft. This feature will also provide ECG with information on network conditions at customer supply points.

This activity will reduce commercial losses and improve revenue collection efficiency. It will help to improve network reliability.

#### 1.4.1.2.2.2 Re-routing of Concealed Service Tails

It is proposed to re-route 223,600 service tails (156,000 single phase and 67,000 three phase) for existing connections.

This is to ensure that service tails comply with ECG regulations by being visible from pole top to meter terminal cover. Activity will also relocate meters to acceptable locations.

In the past, ECG permitted service tails to be concealed in ceilings and walls. It is customary for customers intent on stealing power to connect high energy consuming equipment such as water heaters, air conditioners, and electric cookers directly to concealed portions service tails before the meter thereby by-passing the meter. ECG changed this service connection procedure about ten (10) years ago but there is still a large number of concealed service tails that need to be re-routed.

This activity will reduce commercial losses.

#### 1.4.1.2.2.3 Network Metering

It is proposed to install meters with automatic meter reading capability at key locations of the network in order to track the flow of electricity into, out of and through the network to loads. Proposed locations are listed below.

It is proposed to install about 40 meters at BSPs on incomers from GRIDCo and outgoing feeders as well as at connection points for embedded generation.

Networks in one operational region are often connected to networks located in other operational regions. It is therefore intended to install about 40 meters with associated instrument transformers on electricity lines at regional boundaries.

It is intended to install about 120 meters at primary substations on power transformers and on outgoing feeders.

It is proposed to install about 1,460 meters at the low voltage terminals of distribution substations.

This activity will provide information that will be used in energy accounting as part of efforts to identify areas of high system losses. Identification of areas with high system losses will be the first step in systematic inspections of service connections and testing of meters.

## 1.4.1.3 Reinforcement of Distribution Networks

### *1.4.1.3.1 Bulk Supply Station (161/ 33kV) and associated 33kV networks*

It is proposed to construct the ECG side of a new bulk supply station (161/ 33kV) station and 73km of 33kV double circuit lines to link the bulk supply station with 33kV networks.

The proposed station will provide additional 33kV capacity for Tema Township and surrounding communities. As an additional bulk supply station, it will improve reliability at 33kV level. Voltage profiles will improve and technical losses will reduce within Tema's 33kV networks.

#### *1.4.1.3.2 Construction of two primary (33/11kV) substations and associated networks*

It is proposed to construct two new primary (33/11kV) substations with associated 33kV supply circuits and 11kV circuits at Community 2 and Tema Trade Fair.

The proposed primary substations will provide additional 11kV capacity to serve areas near Tema Sea Port and Tema Trade Fair. Both areas have experienced a high rate of development. Proposed primary substations will help to reduce lengths and loading of some 11kV feeders. This activity will therefore contribute to technical loss reduction. By reducing loading of 11kV feeders, the new substations will help reduce outage durations by making feasible the transfer of loads from faulty 11kV feeders and primary substations to healthy 11kV feeders and primary substations. Reducing length of 11kV feeders will improve reliability of feeders.

This activity will increase 11kV network capacity as well as improve reliability and quality of supply. It will also reduce technical losses.

#### *1.4.1.3.3 Construction of 33kV and 11kV Feeders*

It is proposed to construct 13km of 33kV overhead line from Dawhenya to Bondase to assist existing 33kV Ada feeder from Sogakope. It is also proposed to construct 46km of 11kV overhead lines and 24km of 11kV underground cable circuits either as new feeders from primary substations or as extensions of existing feeders.

This activity will reduce load levels on existing feeders and improve the linkages between primary substations. In so doing, it becomes possible to provide alternative supplies to loads in the event of faults until faults are rectified. The benefit of this activity is that impact of any one fault in terms of time to restore supply, the number of customers affected and energy not supplied are reduced.

This activity will increase network capacity, reliability and quality of supply in 33kV and 11kV networks. It will also reduce technical losses within 33kV and 11kV networks.

#### *1.4.1.3.4 Low Voltage Network Improvement*

It is intended to construct about 700 distribution substations and install associated 33kV and 11kV supply lines and LV networks.

The purpose is to provide additional LV capacity to meet demand for electricity. Activity will also reduce loading on overloaded transformers and LV networks as well as reduce lengths of LV lines. Some low voltage networks have been assessed as being in a deplorable state and will be rehabilitated.

The ECG distribution system in the Tema Operational area is predominantly low voltage (230V/ 400V) distribution characterised by large capacity (typically 200kVA – 1000kVA) distribution transformers and long low voltage lines. This approach to distribution results in relatively high technical losses and low reliability of supply at LV. Under Compact II, ECG will utilise smaller capacity (50 – 100kVA) distribution transformers in its low voltage network improvement. This change in practice is to reduce technical losses. This activity will help improve the quality and reliability of supply.

This activity will increase low voltage capacity as well as improve reliability and quality of supply. Technical losses will be reduced.

#### 1.4.1.4 Network Control

##### *1.4.1.4.1 Implementation of 11kV Distribution Automation*

It is intended to automate eighty one (81) 11kV feeders by installing distribution automation systems to enable automatic detection and clearance of faults, transfer of un-faulted feeder sections to lightly loaded healthy feeders and restoration of the optimum network configuration.

The benefit of this activity is reduced impact of outages as a result of reduced time to restore supply. Reduced time to restore supply implies reduced quantity of energy not supplied as result of outages.

### 1.4.2 Distribution – NEDCo (Project 2B)

#### 1.4.2.1 Institutional Support

Institutional Support will focus on improving performance in NEDCo at the regional level.

Institutional support activities are proposed because it is recognised that provision of distribution infrastructure alone will not result in a fundamental or sustained change in NEDCo's performance. It is accepted that there also need to be increased management accountability and better decision support information combined with changes in procedures as well as attitude, performance and supervision of employees.

##### *1.4.2.1.1 Technical Assistance for Tamale Operational Area*

It is proposed to improve the performance of Tamale Operational Region in areas of technical and commercial operations by providing technical assistance. It is intended that this activity will make the region more responsive to the needs of stakeholders. The details of technical assistance have not yet been determined. However, it is anticipated that this activity will include a mix of diagnostic studies followed by remedial processes, attachment of staff from advanced utilities and development of new business procedures. A key component will be to assist in the reinforcement of staff knowledge. The project will advocate among others for qualified females in management positions. The following areas are proposed as part of technical assistance to Tamale:

a) Counterpart Staff – It is proposed that staff from advanced utilities be twinned with key personnel in Tamale Region. Such persons will act as agents of change as well as assist, guide and mentor NEDCo staff during transition to a well operated unit. They will also assist to make operational the various improvements proposed for Tamale.

b) Reengineering of business processes – It is necessary to reengineer business processes to achieve aggressive loss reduction, improve revenue processes and provide good quality service to customers. It will also be necessary to ensure that the GIS is maintained and the GIS based Distribution Management System is fully utilised. Areas of concern include network construction, network operations, maintenance, fault location and customer management. An element of reengineering will be reinforcement of quality systems.

c) Staff Reorientation – It will be necessary to assist NEDCo staff appreciate implications of NEDCo's status separate from VRA in relation to financial and technical performance.

d) Staff Training – It is proposed to upgrade the capacity of staff through training in a number of key areas utilising funds from the Compact. The training programs will involve all categories of staff at Tamale Operational Region as well as those staff who provide services to or interact with Tamale Operational Region. Training will cover new business procedures introduced in Tamale as well as general skills training where deficiencies are identified.

e) Loss Reduction - Consultancy and Training – This component is specifically required to support the systematic reduction of losses as well as the setup and operation of the GIS based Distribution Management System.

#### *1.4.2.1.2 Energy Loss Control Centre*

It is proposed to establish an Energy Loss Control Centre (ELCC) to receive and analyse data from AMR meters and use the information primarily for loss reduction and also for network planning, operations and fault location.

The ELCC will analyse data to provide information such as purchases, sales and loss indicators at regional and district level. It will also estimate technical losses.

The ELCC will be responsible for managing the Loss Control Unit (LCU). It will use data from meters to alert the LCU of tamper attempts. It will also identify areas of high losses in order to prioritise such areas for investigation by loss control units. The ELCC will analyse customer (SLTs and the larger non-SLTs) consumption patterns to identify abnormal patterns for investigation by loss control units. As part of its responsibility for loss control, the ELCC will monitor performance of the LCU. It will also track ECG's performance with respect to prosecutions relating to power theft.

The ELCC will identify outages at the distribution level using data from network and customer metering and inform fault correction units. The ELCC will also be responsible for generating reliability indicators at regional and district level.

The ELCC will be responsible for power supply monitoring to generate load curves and to estimate parameters such as load factor, loss factor and maximum demand. Information will be useful in network planning and design to help ensure that power quality is acceptable.

The ELCC will provide summary information to NEDCo management and other stakeholders.

The ELCC allows systematic reduction of losses and more efficient network planning. It will help to improve the reliability of networks.

### *1.4.2.1.3 Geographic Information based (GIS) Distribution Management System*

It is proposed to implement a GIS based Distribution Management System (GDMS) for networks (33kV, 11kV and low voltage) and customer related information within the Tamale Operational Region. GDMS is essential to a systematic loss reduction effort because it provides the means to undertake energy accounting and to determine losses by feeder and transformer. [11]

Implementation of the GDMS will involve the following activities

- Provision of IT and related infrastructure
- Global Positioning System (GPS) based mapping of networks at 33kV, 11kV and LV levels
- Enumeration and GPS based mapping of customers
- Linking of GIS with customer information database

It is important that the GIS is up to date in that it ought to show the current status of networks and customers at any time. In order to achieve this, it is essential that business procedures be changed so that the GIS is at the heart of network construction, operation and maintenance. It is also necessary for the GIs to be central to customer management. Without satisfactory changes to business procedures, there will be no point in attempting to set up a GDMS because it will not be possible to maintain the GIS and customer indexing.[12]

The following enterprise processes will be built onto the GIS

a. Network planning and design
b. New customer management
c. Asset management, including asset maintenance system and asset outage systems

The main benefit of the proposed GDMS is the ability to link spatial information with technical and load data to in a manner that will enable NEDCo to make informed decisions. This benefit is expected to result in effective loss reduction programs, more cost effective network improvement schemes, better quality of supply and more reliable statistics.

### *1.4.2.1.4 Customer Care Centre*

It is proposed to establish a Customer Care Centre (CCC) to ensure satisfactory response to all customer inquiries, application for service and complaints including faults. CCC will operate round the clock. It will be staffed by operators who will receive all regional customer requests by telephone, short message service (sms) and email.

All calls will be numbered and stamped with time and date. They will be monitored until issue is resolved satisfactorily. Customers will be able to track progress on complaints over the internet or by

[11] National Technical and Commercial Loss Study Executive Summary for NEDCo – Global Energy Consulting Engineers, 2012
[12] National Technical and Commercial Loss Study Executive Summary for NEDCo – Global Energy Consulting Engineers, 2012

telephone follow-up. Supervisors will receive reports based on elapsed time since report etc. to identify situations of delayed resolution.

Operators will be supported by GIS based distribution management system.

#### *1.4.2.1.5 Loss Control Unit*

It is proposed to improve the regional loss control unit to become a more effective deterrent to electricity theft. This activity will focus on providing equipment, training and improved procedures. This activity will be complemented by improved staffing, application of sanctions to culpable ECG staff and vigorous legal prosecution. The overall intention is to increase the proportion of services and meters inspected and to improve effectiveness of performance.

The main benefit of the enhanced Loss Control Unit is reduction in commercial losses by detecting causes of commercial losses and discouraging theft of electricity.

### 1.4.2.2 Improvement in System Losses and Improvement of Revenue Collection

#### *1.4.2.2.1 Reduction of Technical Losses*

##### 1.4.2.2.1.1 Reactive Power Compensation

It is also intended to install about 5.7MVAr of reactive compensation (capacitor banks) on selected medium voltage feeders to improve power factor. It is expected that that voltage profiles along feeders will improve and that technical losses will be reduced.

##### 1.4.2.2.1.2 Reinforcement of Distribution Network

Activities proposed under the section 1.4.2.3 titled Reinforcement of Distribution Network will yield reductions in technical losses as a side benefit. Activities are summarised below and are discussed in greater detail in section 1.4.2.3.

- Construction of primary (34/11kV) substations at Islamic Sec., Fuo and Banvim – Activity will enable electricity previously distributed at 11kV to be distributed at 34kV.
- Construction of 34kV lines and installation of transformers to replace shield wire schemes – Activity will reduce network impedance.
- Installation of low voltage distribution substations and networks – Activity will reduce loading and lengths of low voltage networks.

### *1.4.2.2.2 Reduction of Commercial Losses and Improvement of Revenue Collection*

#### 1.4.2.2.2.1 Relocation of Energy Meters

It is proposed to relocate 60,000 energy meters and re-route associated service connections.

There are a number of meters installed at unauthorised locations within customer premises. This leads to situations in which service connections cannot be readily inspected or meters cannot be accessed and read. The incorrect location of meters also leads to installation of service connections along unauthorised routes and this provides the opportunity for unmetered and illegal consumption of electricity.

It is anticipated that this activity will result in reduced losses due to reduced meter bypasses or meter tampering. Improved access to meters will enable NEDCo ensure that customer billing (for credit meters) is based on actual meter readings rather than on estimates of consumption.

#### 1.4.2.2.2.2 Installation of Prepayment Meters

It is proposed to install 150,000 prepayment meters in the Tamale Operational Area. Meters will be installed in sealed enclosures at approved locations in order to minimise tampering.

There are a number of credit meters in Tamale that are not accurate and so contribute to high losses. Furthermore, NEDCo's rate of revenue collection is unacceptably low.

This activity is expected to lead to reduced overall level of errors and reduced losses. It is also expected to improve revenue collection.

#### 1.4.2.2.2.3 Network Metering

It is proposed to install meters with automatic meter reading capability at key locations of the network in order to track the flow of electricity into and through the network to loads. Proposed locations are listed in following paragraphs.

It is proposed to install about 20 meters at BSPs on incomers from GRIDCo and outgoing feeders.

Networks in one operational region are often connected to networks located in other operational regions. It is therefore intended to install about 20 meters with associated instrument transformers on electricity lines at regional boundaries.

It is intended to install about 20 meters at primary substations on power transformers and on outgoing feeders.

It is proposed to install 1,000 meters at the low voltage terminals of distribution substations.

This activity will provide information that will be used in energy accounting as part of efforts to identify areas of high system losses. Identification of areas with high system losses will be the first step in systematic inspections of service connections and testing of meters.

## 1.4.2.3 Reinforcement of Distribution Network

### *1.4.2.3.1 Construction of 34/11kV Substations*

It is proposed to construct three 34/11kV substations, associated 34kV supply lines and 11kV outgoing feeders to tie into existing networks as in summaries below.

- Construction of 5MVA, 34/11kV Islamic Sec Substation, Tamale with 10km 34kV line, 6km 11kV line
- Construction of 5MVA, 34/11kV Fuo Substation, Tamale with 6km 34kV line, 6km 11kV line
- Construction of 5MVA, 34/11kV Banvim Substation, Tamale with 12km 34kV line, 6km 11kV line

Benefits from these activities will include reduced technical losses, improved reliability at 11kV and better operational flexibility. Activities will also increase capacity of 11kV network. Activities will defer the need to upgrade the BSP's transformer by applying a portion of BSP's 34kV capacity to provide 11kV supply.

### *1.4.2.3.2 Replacement of Shield Wire Scheme Lines*

It is proposed to construct two conventional lines to replace existing shield wire scheme (SWS) lines.

- Construction of a 60km 34kV line from Buipe to Yapei and installation of distribution substations to serve communities along the route.
- Construction of 34kV line from Pwalugu through Walewale to Nasia and installation of distribution substations to serve communities along route.

This activity will provide beneficiary areas with access to three phase electricity supply and will permit use of larger motors as may be required for commercial activities. Other benefits include improvement of voltage profile and reduction of technical losses.

### *1.4.2.3.3 Low Voltage Network Improvement*

It is proposed to install distribution substations and associated low voltage networks. Scope of activity is provided below.

- LV networks in vicinity of proposed Islamic Sec substation – 10km 415V line and about 20 distribution substations.
- LV networks in vicinity of proposed Fuo substation – 10km 415V line and about 20 distribution substations.
- LV networks in vicinity of proposed Banvim substation – 10km 415V line and about 20 distribution substations.
- Construction of 136km of 11kV lines to supply new distribution substations, installation of 92 distribution substations (100kVA typical) and construction of 535km of LV networks to serve about 11,000 customers.

The main benefit will be additional low voltage capacity which will enable NEDCo to provide electricity to prospective customers who hitherto have not been connected due to overloads. It is also expected that technical losses will be reduced, reliability will improve and quality of supply will get better. The likelihood of damage to network components as a result of overloads will reduce.

### 1.4.3 Access to Electricity – Isolated Communities (Project 5C)

The SGA Team will be part of the community selection process and facilitate local involvement in the planning and implementation process. It is proposed to provide use off grid photo voltaic units to provide electricity to fifty difficult to reach communities such as lakeside and island communities. Photo voltaic is preferred to wind or other renewable technologies because of the extent of knowledge of availability of solar energy relative to other sources of renewable energy in the area of interest.

It is planned that 60 photo voltaic systems will be provided for socially important facilities such as health posts and schools. A total of 640 solar powered lights will be installed at vantage points within selected communities to provide public lighting. A battery charging station will also be provided within each community.

As part of this activity, it is intended to train technically inclined persons in basic maintenance of the units. The SGA Team will assist in the identification of potential local personnel for training in solar maintenance.

It is anticipated that schools and health facilities that benefit from this activity will be able to improve the quality of services provided. It is also expected that economic activities will develop as a result of provision of public lighting.

### 1.4.4 Access to Electricity – Peri-Urban Communities (Project 5B)

It is proposed to install distribution substations and associated low voltage networks to extend electricity facilities to improve access to electricity by occupants of already electrified rural communities. It is estimated that about 130 communities will benefit from this activity and that 100,000 customers will be connected. The SGA Team will be part of the selection process. Service connection fees will be subsidised within a certain period after project commissioning in order to reduce barriers to connection.

The main benefit is the increase in access to electricity within selected socially deprived communities. Other benefits are improvements in reliability and quality of supply (for overloaded networks) and reduction in damage to electricity infrastructure.

### 1.4.5 Access to Electricity – Economic Enclaves (Project 5A)

It is proposed to improve electricity supply infrastructure to centres of economic activity or providers of social services. The SGA Team will be part of the selection of the economic enclaves. The various components of this activity are described below.

## 1.4.5.1 Markets

It is proposed to extend or reinforce networks that supply electricity to and distribute electricity within selected markets. As part of efforts to improve ability to fight fires within markets, supply

arrangements will pay particular attention to ease of switching of incoming feeders. Public lighting will be improved to extend hours of operation.

Service connections will be rationalised to ensure that all readily identifiable users of electricity are registered, properly connected and billed. The SGA Team will engage stakeholders to discuss service connection fee.

As part of this activity, it is proposed to encourage mechanised processing of agricultural products by promoting the use of electrically powered multi-functional platforms (MFP). Qualified firms will be invited to identify and promote suitable equipment for use as MFPs. Participants will be provided training in maintenance and sanitation.

It is proposed to cover ten major markets as part of this activity.

#### 1.4.5.2 Economic Enclaves

It is proposed to upgrade electricity networks that serve selected economic enclaves to ensure that networks are of adequate capacity and coverage. Service connections will be rationalised to ensure that all identifiable users of electricity are registered, properly connected and billed.

#### 1.4.5.3 Schools Constructed Under Compact I

It is proposed to extend electricity supplies to those schools constructed under Compact I that currently are not connected to the electricity grid. This activity will include service connections to schools.

#### 1.4.5.4 Health Facilities

It is proposed to extend electricity supply to health facilities that do not have access to electricity. This will involve extension of networks and provision of service connections. In communities that are very socially deprived and whose health facilities do not have suitable internal wiring, wiring will be provided as part of this activity.

#### 1.4.5.5 Irrigation Sites

Electricity networks were constructed under Compact I to supply farmers operating at irrigation sites. It is proposed to extend low voltage networks to provide improved coverage to farmers.

### 1.4.6 Demand Side Management (Project 4)

It is proposed to undertake a sustained nationwide gender sensitive public education and awareness building campaign to educate the electricity consuming public on the methods and benefits of electricity conservation and efficiency. The educational campaign will utilise the print and electronic media. It will also hold a number of public fora in selected communities to educate the public on specific steps they can take to reduce electricity waste and save money on their electricity bills. The SGA Team will assist in the identification of qualified young female scientists as part of the campaign program.

It is also proposed to implement a program to train energy managers in industry as well as energy service providers to equip them with the knowledge and skills to better identify, justify and implement energy efficiency improvement opportunities at their organisations and for their clients.

As a part of the training component, energy audits will be provided to selected commercial and industrial entities. Results will be developed into case studies as part of the promotion of energy audits.

It is proposed to undertake a campaign to assist SLT customers with poor power factor to undertake power factor improvement projects. The campaign will identify SLT customers with poor average power factors. It will then prepare, for each selected customer, a brief data sheet tailored to the electricity consumption characteristics of the particular customer. The sheet will provide realistic implementation costs alongside estimated reductions in electricity bills. Meetings will be held with key technical and financial personnel of the customer to discuss issues relating to benefits of power factor improvement. Potential barriers to implementation will be identified and suggestions made to resolve problems.

It is proposed to develop and establish standards for the following items:

- Tubular fluorescent lamps and ballasts
- Motors (including those used in circulating fans)

Training program will create an energy efficiency conscious set of employees who, regardless of where they may find themselves, will look for opportunities to implement energy saving initiatives.

Overall power factor of distribution companies is expected to improve and technical losses will be reduced as a result of power factor improvement campaign. Customers who take part in power factor improvement activity will see reductions in their electricity bills.

Establishment of standards for selected items will lead to enforcement which in turn will increase efficiency of use of electricity.

## 1.5 Estimated Cost

Estimates provided in the following sections exclude provisions for contingencies and project management.

### 1.5.1 Distribution – ECG (Project 2A)

**Table 6 – Summary of Cost Estimates for Distribution – ECG (Project 2A)**

| ITEM | DESCRIPTION | COST (US$ million) |
|---|---|---|
| 1 | Institutional Support | |
| 1.1 | Energy Loss Control Centre (includes customer care applications at approx. $1m) | 4.32 |
| 1.2 | GIS based Distribution Management System<br>GIS data collection | 2.92<br>3.23 |
| 1.3 | Customer Care Centre | 0.50 |
| 1.4 | Loss Control Unit | 0.20 |
| 1.5 | Technical Assistance to Tema Operational Region[1] | 10.00 |
| | **Sub-total** | **21.17** |
| 2 | Reduction in System Losses and Improvement in Financial Performance | |
| 2.1 | Provision of reactive power compensation (70.2MVAr) | 2.86 |
| 2.2 | Replacement of meters with split type prepayment meters with automatic reading capability (445,000 sets) | 97.90 |
| 2.3 | Re-routing of concealed service tails | 6.52 |
| 2.4 | Network Metering | 3.20 |
| | **Sub-total** | **110.48** |
| 3 | Reinforcement of Network | |
| 3.1 | Construction of bulk supply station at Afienya with associated network | 10.90 |
| 3.2 | Construction of two primary substations with associated 33kV and 11kV network at Community 2 and Tema Trade Fair | 8.30 |
| 3.3 | Construction of 33kV and 11kV feeder interconnections | 3.11 |
| 3.4 | Low voltage (415V) Network Improvements | 25.74 |
| | **Sub-total** | **48.05** |
| 4 | Network Control | |
| 4.1 | Automation of 81 11kV feeders | 16.20 |
| | **Sub-total** | **16.20** |
| | **Total** | **195.90** |
| | | |
| | Portion to be provided by private investment (2.2, 2.3) | 104.42 |
| | Portion to be provided under Compact II | 91.48 |

[1]Includes TA for SG integration activities

### 1.5.2 Distribution – NEDCo (Project 2B)

**Table 7 – Summary of Cost Estimates for Distribution – NEDCo (Project 2B)**

| ITEM | DESCRIPTION | COST (US$ million) |
|---|---|---|
| 1 | Reduction in System Losses and Improvement in Financial Performance | |
| 1.1 | Prepayment meters for Tamale customers (150,000) | 15.00 |
| 1.2 | Metering software, vending stations, master control station, wide area network for prepayment meters. | 2.00 |
| 1.3 | Relocation of meters for 60,000 Customers | 3.00 |
| 1.4 | Reactive power compensation using capacitor bank installations at 11kV and 34kV throughout NEDCo | 0.90 |
| 1.5 | Network Metering | 1.99 |
| | **Sub-total** | **22.89** |
| 2 | Reinforcement of Distribution Network | |
| 2.1 | 5MVA 34/11kV Islamic Sec Substation with 10km 34kV, 6km 11kV and 10km LV lines as well as 20 distribution substations | 2.10 |
| 2.2 | 5MVA 34/11kV Fuo Substation with 6km 34kV, 6km 11kV and 10km LV lines as well as 20 distribution substations | 1.97 |
| 2.3 | 5MVA 34/11kV Banvim Substation with 6km 34kV, 6km 11kV and 10km LV lines as well as 20 distribution substations | 2.16 |
| 2.4 | 60km 34kV line from Buipe to Yapei and replacement of shield wire transformers (3 no) | 2.00 |
| 2.5 | Construction of 34.5kV line from Pwalugu to Walewale to Nasia and replacement of shield wire transformers (35 no) | 1.33 |
| 2.6 | Network reinforcements for Tamale Operational Area (136km of 34kV and 11kV line, 92 distribution substations, 535km of low voltage line) | 10.07 |
| | **Sub-total** | **19.63** |
| 3 | Institutional Support | |
| 3.1 | Energy Loss Control Centre (includes $1m for building) | 5.32 |
| 3.2 | GIS based Distribution Management System<br>GIS data collection | 2.92<br>1.50 |
| 3.3 | Customer Care Centre | 0.50 |
| 3.2 | Loss Reduction Unit | 0.20 |
| 3.3 | Technical Assistance[1] | 5.00 |
| | **Sub-total** | **15.44** |
| | **Total** | **57.96** |

[1]Includes TA for SG integration activities

### 1.5.3 Access to Electricity – Isolated Communities (Project 5C)

**Table 8 – Summary of Cost Estimates for Access to Electricity – Isolated Communities (Project 5C)**

| ITEM | DESCRIPTION | COST (US$ million) |
|---|---|---|
| | Photo voltaic (PV) systems for health facilities and schools (60 sets) | 0.195 |
| | PV public lighting (640 sets) | 1.344 |
| | PV Battery charging stations (50 sets) | 0.384 |
| | Basic training | 0.060 |
| | **Total** | **1.983** |

### 1.5.4 Access to Electricity – Peri-Urban Communities (Project 5B)

**Table 9 – Summary of Cost Estimates for Access to Electricity – Peri-Urban Communities (Project 5B)**

| ITEM | AREA (Region) | COST (US$ million) |
|---|---|---|
| 1 | ECG Operational Area | |
| | Ashanti | 6.65 |
| | Central | 9.14 |
| | Eastern | 6.09 |
| | Greater Accra | 1.88 |
| | Volta | 2.00 |
| | Western | 2.74 |
| | **Sub-total** | **28.50** |
| 2 | NEDCo Operational Area | |
| | Northern | 5.66 |
| | Brong Ahafo | 0.90 |
| | Upper East | 1.95 |
| | Upper West | 1.65 |
| | **Sub-total** | **10.16** |
| | **Total** | **38.66** |

### 1.5.5 Access to Electricity – Economic Enclaves (Project 5A)

**Table 10 Summary of Cost Estimates for Access to Electricity – Economic Enclaves (Project 5A)**

| ITEM | Sector | COST (US$ million) |
|---|---|---|
| | Markets | |
| | Schools constructed under Compact I | |
| | Economic Enclaves | |
| | Health facilities | |
| | Irrigation Facilities | |
| | **Total** | **10.00** |

The above budget total is a nominal figure. It will be refined as detail engineering and nominated beneficiaries are processed.

### 1.5.6 Demand Side Management (Project 4)

**Table 11 – Summary of Costs for Demand Side Management (Project 4)**

| ITEM | DESCRIPTION | COST (US$ million) |
|---|---|---|
| 1 | Public Education and Awareness Building Programme. | |
| | Placement of Energy Conservation promotional adverts in nationally circulated newspapers | 0.150 |
| | Production of Energy Conservation Promotional Jingles (Including Local languages) for use on radio | 0.025 |
| | Airing of Jingles on Select FM Radio stations | 0.175 |
| | Production of Energy Conservation TV Commercials | 0.150 |
| | Airing of TV Commercials on National Television stations | 0.400 |
| | Energy fora: Discussion of Energy Conservation concepts and methods and benefits at various communities nationwide - 3 Communities per region each year | 0.100 |
| | Administration | 0.100 |
| | **Sub-total for five year period** | **1.100** |
| 2 | Energy Management Training | |
| | Consultant Trainers (air ticket, fees and incidental costs) | 0.160 |
| | Conference facilities and lodging | 0.080 |
| | Local transportation | 0.030 |
| | Support services, literature etc. | 0.030 |
| | **Sub-total (to cover 2 visits to Ghana by consultant)** | **0.300** |
| 3 | Energy audits of selected commercial and industrial firms | |
| | **Sub-total** | **0.100** |
| 4 | Development and Establishment of standards | |
| | Standards for fluorescent lamps and ballasts | 0.100 |
| | Standards for electric motors | 0.100 |
| | **Sub-total** | **0.200** |
| 5 | Power factor improvement campaign (selected SLT customers) | 0.100 |
| | **Sub-total** | **0.100** |
| | **Total** | **1.800** |

### 1.5.7 Summary of Costs

**Table 12 Summary of Costs**

| ITEM | Activity Group | COST (US$ million) |
|---|---|---|
| 1 | Distribution - ECG | 195.90 |
| | Distribution – NEDCo | 57.96 |
| | Access to Electricity – Off Grid | 1.98 |
| | Network Intensification | 38.66 |
| | Access to Electricity for Productive Uses | 10.00 |
| | Demand Side Management | 1.80 |
| | **Total** | **306.30** |
| | **Private sector costs (1.2 & 1.3 in Table 6 – Summary of Cost Estimates for Distribution – ECG (Project 2A) )** | 104.42 |
| | Compact II costs | 201.88 |

Estimates provided in the above table exclude provisions for contingencies and project management.

# 2 Project Context and Development Plans

## 2.1 Sector and Strategy Description

### 2.1.1 Role of Electricity in the National Economy

Electricity forms 9% of the total energy used in the country. At 69%, it is the dominant modern form of energy used in the industry and service sectors of the national economy. The electricity supply industry provides employment for a significant number of Ghanaians. Electricity is an important source of foreign exchange earnings through exports of power to neighbouring countries of Togo, Benin and Burkina Faso.[13]

### 2.1.2 Roles of Government and the Private Sector

National energy policy is set by the Ministry of Energy with technical advice from the Energy Commission (EC). The EC is also responsible for licencing and setting rules of operation for the transmission, wholesale supply, distribution and sale of electricity as well as natural gas. The Public Utilities Regulatory Commission of Ghana (PURC) is an independent body responsible for regulating and overseeing the provision of electricity and water services to consumers. Tariffs for the regulated market are set by the PURC.

The Volta River Authority (VRA) undertakes generation as well as management and development of the Volta Lake. VRA also undertakes distribution in the northern part of Ghana through a subsidiary, The Northern Electricity Company (NEDCo). Bui Power Authority (BPA) is responsible for planning, executing and managing the Bui Hydroelectric Project. GRIDCo is responsible for operating the national transmission system. The Electricity Company of Ghana is a limited liability company that is responsible for distribution of electricity in southern Ghana. These entities are entirely GOG owned.

Other players in the electricity sector have various degrees of private ownership. The Takoradi International Company (TICO), a thermal generation company, is a private public partnership between TAQA and VRA. Sunon Asogli power plant, on the other hand, has no GOG ownership. A private firm, Enclave Power Company, provides electricity distribution services in the Tema Free Zone Enclave.

The private sector provides significant levels of services in the construction, maintenance and operation of the electricity supply sector especially in distribution. Areas of participation range from involvement in construction of power plants, transmission and distribution networks to operation of portions of small distribution networks to providing customer related services such as meter reading and bill delivery.

[13] Ghana Shared Growth and Development Agenda (GSGDA), 2010 – 2013, Volume I: Policy Framework

### 2.1.3 Selection of Concept Projects

## 2.1.3.1 Ghana Constraints Analysis

It has been determined that, while the Ghanaian economy has grown at a reasonable rate over the past decade, it was unlikely to result in the kind of transformation sought. Furthermore, growth has been driven substantially by public investment based on aid and private investment has been slow.

A Constraints Study was conducted by a joint United States/ Ghana team to identify and investigate the most binding constraints to private sector growth. The three most binding constraints were identified as Credit – limited, expensive and short term; Power – insufficient and unreliable; and Insecure property (land use) rights. The study estimated the overall cost of the power constraint to the economy at about 5.6 % of gross domestic product. Government of Ghana agreed with the conclusion and accordingly proposed that Ghana's Compact II should focus on 'inadequate and unreliable supply of electric power'.

## 2.1.3.2 Electricity Sector Problem Analysis

Analysis by stakeholders of the causes and effects relating to the problem of "inadequate and unreliable supply of electric power" resulted in identification of "distribution system is constrained and inefficient" as a key node. The recurring theme of root causes of this situation is the operational inefficiencies of the utilities. It was concluded that these inefficiencies arise out of high technical losses, high commercial losses and ineffective revenue collection mechanisms.

Reduction of technical losses requires significant levels of investment. However, reinforcement and capacity expansion activities will lead to minor reduction in technical losses in addition to improvement in reliability. In order to obtain adequate funding to sustain network improvements, it is important to prioritise reduction of commercial losses and improvement in revenue collection because these may be done with lower levels of investment. The anticipated return on investment for these activities is also high. The increased revenue arising out of these activities will enable the distribution companies, particularly ECG, to undertake sustained capacity expansion as well as improve its commercial operations. The increased revenue is expected to lead to improvements in distribution utilities' balance sheets and make them more credible as final customers for IPPs.

The additional revenue is expected to lower the barriers to some outstanding reforms of the distribution sector. This is because if ECG becomes profitable, it becomes possible to merge ECG and NEDCo into a single entity and then create regional companies as envisaged under the Strategic Business Unit (SBU) concept. In that case there may be cross payments between units via a holding company but no external support will be required similar to what is provided to NEDCo. An alternative approach is to leave ECG and NEDCo separate but to require transfer payments from ECG to NEDCo as part of cross subsidies designed into the tariff to compensate NEDCo for its customer and load profile.

However, until the interventions relating to commercial losses and revenue collection take effect, it is proposed to undertake increase network capacity to meet demand, improve reliability and improve quality of supply to customers. One reason is to make revenue improvement activities more palatable to customers. This approach is based on previous experiences in which customers were

more accepting of revenue improvement activities when these were clearly related to improvements in quality of supply.

It is apparent that previous investments in ECG in particular have not had sustained impact on the overall performance of ECG. Further infusion of money is unlikely to change ECG's performance without fundamental changes in attitude within the company. The institutional support component is therefore intended to initiate and guide necessary changes that will help sustain improvements. The institutional support component is particularly desired to foster a commercial and customer focused attitude to ECG's activities.

### 2.1.3.3 Focal Areas

Investment requirements of the distribution sector exceed several times what the Compact may be expected to provide for the entire electricity sector. The geographical area covered by institutions involved make the task of reform of operation extremely difficult especially within the duration of the proposed Compact. It is therefore proposed that areas of operation be limited geographically where practical. A summary of focal areas for various activities is provided in the following table.

**Table 13 – Focal Areas for Activity Groups**

| **Activity Group** | **Geographic Area** |
|---|---|
| Distribution – Institutional Support, Loss Reduction, Reinforcement of Distribution Network | Tema Operational Region (ECG)<br>Tamale Operational Region (NEDCo) |
| Access to electricity – Renewable Energy | Selected lakeside and island communities |
| Intensification of peri-urban networks | Selected communities nationwide |
| Increased access to electricity for productive uses | Selected economic enclaves, markets and social facilities nationwide |
| Demand side management | Nationwide |

ECG has already committed to undertake loss reduction activities in (part of) Accra East, Accra West, Ashanti East and Ashanti West operational regions under funding initiatives outside Compact II. Western, Central, Eastern, Volta operational regions are considered to be of limited commercial potential immediately. Tema Operational Region has the necessary customer base and potential revenue streams for it to be profitable.

Tema was responsible for 17.6% of ECG's purchases in 2011 and is the leading industrial community in Ghana. It is the location for the larger of Ghana's two sea ports. Its losses deteriorated markedly from 2010 to 2011[14]. Thus Tema is economically important to Ghana, is of financial significance to ECG, it has the potential to perform but faces the risk of substantial deterioration if no effective

[14] Loss study gives 2010 ATC&C loss as 40.98 against 2011 figure of 44.05%. System losses were 26.35% in 2010 and 31.82% in 2011.

interventions are made. Tema is fairly compact and all its parts are readily accessible. Tema also has a mix of different customer types and networks from large industrial to rural residential. It is possible to study the effect of the various interventions on different customer classes. Tema therefore has suitable characteristics to serve as a proving ground for new practices.

Under the proposed reorganisation of ECG into Strategic Business Units (SBUs), it is intended to combine Tema with Eastern and Volta Regions. Tema has the potential to be profitable but Eastern and Volta regions are less likely to be profitable. It is therefore necessary for Tema's performance to improve before attempting to group these three regions into an SBU.

Tamale operating region is responsible for about 30% of NEDCo's total energy purchases. It also has the highest ATC&C loss of 52.65% of all the five operating regions. Reducing Tamale's losses will be a significant step in making NEDCo financially viable.

Renewable energy activities have been designed to take account of the strengths of renewable energy technologies as compared to grid electrification in certain situations. Thus the renewable component focuses on remote areas that will be relatively expensive to connect to the national grid. Ironically, some of these areas became difficult to reach due to flooding associated with formation of the Volta Lake following construction of the Akosombo Hydroelectric Dam.

### 2.1.4 Government Strategies for Development of the Sector

The policy direction will be to seek adequate investment to improve the electricity distribution network and thereby reduce high system losses and improve the poor quality of electricity supply.[15] Government's policy is to:

- Assist distribution utilities to regain their financial health;
- Encourage distribution utilities to seek commercial loan financing to modernise their infrastructure;
- Encourage the injection of investment capital from private sources and from the domestic capital market in the medium to long term and
- Support management in the restructuring of the distribution utilities' operations towards achieving improved operational performance.

There are up to date master plans for generation, transmission and rural electrification. Master plans for distribution are not up to date. However, the distribution utilities have assessed their networks and drawn up medium term development programs.

[15] National Energy Policy, Ministry of Energy – February 2010

### 2.1.5 Government's Broad Policy Framework

The policy objective is to provide adequate and reliable power to meet the needs of Ghanaians and for export. In view of the fact that GOG will be unable to provide the necessary funds to achieve this objective, it is intended to attract private participation in the industry and to improve the operational and financial efficiency of the utilities.

The strategies for achieving GOG's objective are

- Complete the implementation of the power sector reforms
- Develop a non-congested transmission system
- Sustain power generation capacity expansion
    - Institutions in the sector will seek financing for rehabilitation and expansion of existing power plants
    - Complete and operationalize on-going power projects
    - Encourage investment in power infrastructure
- Rehabilitate and reinforce the transmission and distribution system infrastructure to meet projected growth in demand
- Secure reliable and cheap fuel supplies for the operation of the thermal power plants
- Increase access to electricity by consumers especially those in rural areas
- Achieve cost recovery for electricity services
- Reduce power system losses and waste in electricity supply
- Reduce waste in electricity consumption

The key policy objective for renewable energy is to increase the proportion of renewable energy in the national energy mix and contribute through the use of alternative energy sources to mitigate climate change.

### 2.1.6 Links with Other Concept Papers

This concept paper is closely linked with the following concept papers:

- Improved Financial Performance of Utilities In The Electricity Sector
- Increasing Private Sector Investment Through Power Sector Reform

This concept paper describes activities (improvements in metering, technical loss reduction etc.) that are proposed to support efforts to improve the financial performance of utilities. They are in this concept paper only because of convenience. Functionally, activities on loss reduction and institutional support come under Improving Financial Performance of Utilities.

The Distribution Concept Paper addresses improvements in management and infrastructure mainly as a means of improving reliability, loss reduction and revenue collection at the distribution level. For customers to experience reliable and good quality electricity, it is also necessary that generation and transmission facilities also provide reliable services. The Generation Concept Paper as well as Increasing Private Sector Investment through Power Sector Reform Paper address issues related to acquiring adequate generation capacity as way to improving reliability at generation level.

Reform will be required at all levels of ECG if sustainable improvements are to be achieved. Reform at board and senior management issues are addressed in the Increasing Private Sector Investment through Power Sector Reform paper. The Distribution Paper addresses reform within the Tema and Tamale Operational Regions as a part in reforming ECG's and NEDCo's regional operations.

The distribution sector faces financial risks if generation is inadequate because that will result in load shedding and therefore reduced income and higher operating costs. The Increasing Private Sector Investment through Power Sector Reform paper addresses issues related to attracting private finance to the generation sector in particular.

## 2.2 Description of Recent, On-going or Expected Investments in the Sector

### 2.2.1 Recent and On-going Distribution Projects - ECG

| ITEM | PROJECT | BRIEF DESCRIPTION | DURATION | FINANCIER | CURRENCY | AMOUNT | STATUS |
|---|---|---|---|---|---|---|---|
| 1 | Distribution System Upgrade Project (DSUP) | Construction of one Primary Substation, A number of 33kV interconnecting links, procurement of prepayment meters and capacity development of staff | 2004- 2006 | World Bank | US DOLLAR | 15,000,000.00 | **COMPLETED** |
| 2 | Ghana Energy Development & Access Project ( GEDAP) | Construction of one bulk Supply Point (BSP), Eight primary substations, Construction of new District Offices and Customer Services centres, Conversion of low voltage distribution network to high voltage distribution network, shunt capacitor compensation and a number of Capacity development programmes. Grid extension and intensification of network in several rural communities | 2007 - 2014 | Mixed ( ECG, World Bank, African Development Bank, SECO, GEF, etc. | US DOLLAR | 171,000,000.00 | **ONGOING** |
| 3 | GEDAP - Additional Financing | Construction of one new substation, one bulk supply point and procurement of a number of distribution material for network operations and maintenance | 2010 - 2014 | World Bank (IDA) | US DOLLAR | 70,000,000.00 | **ONGOING** |
| 4 | Sub-transmission network improvement Project | Construction of one (1) BSP, two substation, 12No switching stations, 33kV interconnection links and upgrading of rusty coastal overhead lines | 2007 - | Government of Ghana | US DOLLAR | 65,700,000.00 | **ONGOING** |

| ITEM | PROJECT | BRIEF DESCRIPTION | DURATION | FINANCIER | CURRENCY | AMOUNT | STATUS |
|---|---|---|---|---|---|---|---|
| 5 | ECG Network Expansion Project ( French Export Credit) | Construction of four (4) primary substations, construction of interconnecting 33kV links, Reconfiguration of distribution network at market areas, live line training and development | 2008 - 2012 | French Government | EURO | 65,000,000.00 | **ONGOING** |
| 6 | ECG Network Expansion Project (Phase 1) | Construction of six (6) primary substations and 33kV interconnecting lines, capacity development of staff | 2005 - 2007 | Norwegian Government | EURO | 22,000,000.00 | **COMPLETED** |
| 7 | ECG Network Expansion Project (Phase 2) | Construction of seven (7) primary substations and 33kV interconnecting lines, capacity development of staff, supply of standalone mobile substation, supply of distribution materials | 2009-2014 | Norwegian Government | EURO | 55,600,000.00 | **ONGOING** |
| 8 | Network Capacity Expansion | Construction of two (2) new primary substations together with interconnecting feeders | 2007 - | | US DOLLAR | 16,500,000.00 | **ONGOING** |
| 9 | Substations Upgrade Project | Construction of new primary substation and rehabilitations of various others across the country | | Luton Engineering, UK | BRITISH POUNDS | 9,960,399.19 | **ONGOING** |
| 10 | Accra Prepayment meters Build Operate and Transfer (BOT) Project | Replacement of credit meters with Prepayment Meters in Western Accra | | | | | **ONGOING** |
| 11 | Extension of Electricity Supply to Rural Communities (Phase1) | Connection to 417 rural communities | | China EXIM bank | US DOLLARS | 90,000,000.00 | **COMPLETED** |
| 12 | Extension of Electricity Supply to Rural Communities (Phase1) | Connection to 1000 rural communities | | China EXIM bank | US DOLLARS | 170,000,000.00 | **COMPLETED** |

| ITEM | PROJECT | BRIEF DESCRIPTION | DURATION | FINANCIER | CURRENCY | AMOUNT | STATUS |
|---|---|---|---|---|---|---|---|
| 13 | Rural Electrification Project | Connection of 1200 communities to the National Grid | | US EXIM Credit (Weldy Lamount) | US DOLLARS | 350,000,000.00 | **ONGOING** |

### 2.2.2 Expected Distribution Projects - ECG

| PROJECT | Brief Project Description | DURATION | Expected FINANCIER | ESTIMATED TOTAL COSTS | | Status |
|---|---|---|---|---|---|---|
| | | | | CURRENCY | TOTAL AMOUNT | |
| Ghana Energy Development and Access Project (Phase 3) | Construction of Bulk Supply Points (BSPs) and primary substations, Implementation of Teleprotection and Distribution Automation | To be determined | To be determined | | To be determined | Under planning Stage |
| ECG Network Expansion Project (Phase 3) | Construction of Six (6) primary substations and 33kv Interconnecting lines, Capacity development of staff, procurement of distribution materials | To be determined | Norwegian Government | EURO | 75,000,000.00 | under planning Stage |
| Distribution System Improvement Project ( Phase1) | Construction of six (6)new Primary Substations to support load growth on the peripheries of big Cities, implementation of distribution automation on 11kV network | To be determined | To be determined | US DOLLARS | 18,240,000.00 | Under Planning Stage |
| Distribution Network Improvement Projects (Phase 2) | Project Targets injection of distribution transformers to improve voltages and reduce long distribution lines | To be determined | To be determined | US DOLLARS | 17,850,000.00 | Under Planning Stage |

### 2.2.3 Recent and On-Going Distribution Projects – NEDCo

| ITEM | PROJECT | BRIEF DESCRIPTION | DURATION | FINANCIER | CURRENCY | AMOUNT | STATUS |
|---|---|---|---|---|---|---|---|
| | Tamale Teaching Hospital Power Project (TTHPP) | Construction of a dedicated 34.5/11kV substation as part of the main hospital project | | VRA? | | | |
| | Wa, Dalun and Tamale Airport Substations Upgrade under | NEDCo Supply Improvement Project (NSIP) | | VRA | | | |

### 2.2.4 Expected Distribution Projects – NEDCo

| PROJECT | Brief Project Description | DURATION | Expected FINANCIER | ESTIMATED TOTAL COSTS | | Status |
|---|---|---|---|---|---|---|
| | | | | CURRENCY | TOTAL AMOUNT | |
| Buipe 34.5 KV Switching station | 34.5kV Switching Station to supply cement factory, township and nearby communities. Decommissioning of the existing shield wire network. | | VRA | | | |
| Kintampo 34.5 KV Switching Station | 34.5 Switching Station to supply electricity to the township and surrounding towns. Decommissioning of the existing shield wire network. | | VRA | | | |

# 3 Inventory of Existing Preparatory Work

## 3.1 Sector Studies/ Plans

### 3.1.1 Sector Wide

#### 3.1.1.1 National Technical and Commercial Loss Study for ECG & VRA/NED, 2012

The Ministry of Energy engaged a consultant, Global Energy Consulting Engineers, to investigate losses in ECG and NEDCo. The study was funded by the State Secretariat for Economic Affairs (SECO) of Switzerland. The assignment may be summarised as below:

- Determine level of technical and commercial losses
- Identify main causes of high losses
- Define schedule for reduction in losses
- Make recommendations and propose reduction programs and measures to help achieve targets.

#### 3.1.1.2 National Energy Policy 2010

The National Energy Policy document, issued by the Ministry of Energy, presents the government's policy for the current challenges of the energy sector.

The document presents a diagnosis and an analysis of the issues facing the Ghanaian energy sector. It presents a vision for the future and strategy to address the core issues facing the sector. The national energy policy will be implemented through the energy strategy document with action plans.

#### 3.1.1.3 Energy Sector Strategy and Development Plan

This document covers strategies, programs and projects intended to support the national economic development agenda in the following areas of the energy sector:

- Energy Sector Institutions
- Power Sub-sector
- Petroleum Sub-sector
- Renewable Energy Sub-sector
- Waste to energy
- Energy and Gender

### 3.1.1.4 Ghana Country Action Plan for Sustainable Energy for All, June 2012

The United Nations (UN) launched a plan to achieve "Sustainable Energy for All by 2030" with the following key objectives

- Ensuring universal access to modern energy services
- Doubling the rate of improvements of energy efficiency and
- Doubling the share of renewable energy in the global energy mix.

UNDP, in collaboration with other partner agencies, is providing support to Ghana to accelerate progress on the achievement of universal access to sustainable energy by 2030.

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. 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. Targets have also been set for the contribution of renewable energy to the energy mix to more than double.

The situation and emerging opportunities for realizing SE4AL goals is assessed. However, the Ghana SE4ALL Country Action Plan concentrates initially on two main sources of clean modern energy, Liquefied Petroleum Gas and Improved Cook Stoves.

The thrust of projects proposed under the Ghana SE4ALL Country 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.

## 3.1.2 ECG

### 3.1.2.1 Master Plan for Distribution Network Renewal, Reinforcement and Extension 2008

The preparation of this master plan was initiated as part of the Government of Japan's support of the Ghanaian energy sector. The master plan document contained detailed time bound plans for the replacement of deteriorated distribution lines, expansion of distribution facilities in line with demand growth and the reinforcement of the entire network.

### 3.1.2.2 State of the Sub-Transmission Network Report 2011

A study was carried out on the state of ECG's sub-transmission network in June 2011. The study identified weak links within the network and recommended reinforcements required to improve the reliability of the network. The study also analysed the state, stability and load transfer capabilities of the network under various contingency scenarios and made recommendations.

### 3.1.3 NEDCo

## 3.1.3.1 Distribution Master Plan

In 2006, JICA in collaboration with Government of Ghana commissioned Chubu Electric of Japan to conduct studies and develop a 10 year master plan for the distribution sub-sector. The study identified critical constraints in the distribution network for both NEDCo and ECG and proposed an implementation plan. The study was completed in 2008 with funding from Japanese Government.

## 3.1.3.2 Load Flow Studies

In 2011 NEDCo conducted an internal load flow study to identify problems and constraints in the distribution network and update the recommendations of the master plan. This study was conducted by the Planning office of NEDCo and suggested the installation of additional substations and line to meet the current and future demand for electricity.

### 3.1.4 Rural Electrification

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

Recently, the Ministry of Energy (MOE) requested a review of the NES in order to re-optimise the strategy to ensure the efficient and accelerated completion of the remaining phases of the program. Accordingly, a study was conducted that culminated in the review of the NES master plan termed NES Master Plan (2011 – 2020).

The NES Master Plan (2011 - 2020) focuses on the achievement of Universal Access to electricity by year 2020. The Master Plan outlines:

- Work done so far under NES; electrified communities.
- Outstanding work; un-electrified communities.
- The strategy and approach adopted for the NES so far and makes recommendations for the effective pursuit and achievement of the NES goals
- Plans for achieving 100% access by 2020 including suggestions for enhancing the Productive Use of Energy.

## 3.2 Public Consultations

Public consultations were held throughout the country on regional basis. The country was divided into three zones Southern, Middle and Northern. The Southern Zone was made up of Greater Accra, Eastern, Central and Volta Regions. Consultation meetings for the Southern Zone were held at Koforidua, regional capital of the Eastern Region. The Middle Zone was made up of Ashanti, Brong Ahafo, Western and Volta regions. Consultations meetings for the Middle Zone were held at Kumasi, regional capital of the Middle Zone. The Northern Zone was made up of Northern, Upper East and Upper West regions. Consultation meetings for the Northern Zone were held at Tamale, regional capital of the Northern Region.

Participants in public consultations included traditional leaders, non-governmental organisations, regional market organisations, physically challenged persons and representatives of political parties.

Separate stakeholder consultations were held with the private sector, media, Ghana Chamber of Mines and with Parliament.

A separate report will be made available on consultations.

## 3.3 Economic Studies

To be done after the identification of proposed projects

## 3.4 Social and Gender Studies

The Social and Gender Analysis (SGA) document provides an overall gender profile of Ghana and a social and gender analysis of the energy sector. The analysis reveals that the legal and regulatory framework in Ghana promotes the principles of gender equality. The established institutional framework, the Ministry of Women and Children (MoWAC), in collaboration with its partners, spearheads the implementation of legislation to support women and children's issues in the country. Yet MoWAC has limited capacity to undertake its mandate particularly in the area of monitoring and evaluation and the coordination of activities across and among sector ministries. With regards to the socio-economic context, Ghana's commitment to the Beijing Platform of Action (BfA) and the Millennium Development Goals (MDGs) have brought about increased commitments to girls' education. As a result, there have been several educational reforms to address the gaps and inequities in education at all levels. But the challenge is to get more females into science –oriented programs and particularly the engineering sector. In the area of economic activity and access to productive resources, women tend to have limited land access and ownership as compared to men in spite of women's significant contributions to food crop production. Also access to markets remains a challenge and these have implications for women's poverty. Access of the poor to formal financial services or credit is also low in Ghana particularly for women, who operate many small businesses and the rural population.

There is also a low representation of women in decision making positions at all levels. Cultural prejudice rooted in gender stereotypes; women's unwillingness to take up political challenges; the negative self-confidence and perception that many women hold about themselves; difficulties faced by women in gaining access to productive resources are some of the several factors that contribute to women's low participation in decision making at all levels of the Ghanaian economy and in the energy sector in particular. Thus the energy sector is one that is highly male dominated. Other challenges in the sector with regards to gender include the lack of energy sector sex disaggregated

data which makes it difficult to estimate the number of women and men who have access to energy services, lack of persons with gender expertise within the energy sector, no budget for gender integration activities, limited involvement of women in the planning and management of energy services at all levels.

From the above, it is clear that generally women are among the most vulnerable groups that suffer gender inequalities. Specifically within the energy sector of Ghana, women representation at all levels is low. Specific studies will be required in each selected project area to identify clearly the potential social norms and practices that will adversely affect project success.

## 3.5 Supporting Technical Data

Partial list provided, to be finalised

## 3.6 Preliminary Studies

To be initiated

## 3.7 Full Feasibility Studies

To be initiated

## 3.8 Detailed Budgets

To be worked out

## 3.9 Environmental and Social Impact Analysis

Construction of sub-transmission lines and distribution system are being considered, under COMPACT II, by Electricity Company of Ghana (ECG) and Northern Electricity Distribution Company (NEDCo). They propose to reduce technical and commercial losses and also increase network capacity and redundancy and thereby improve on reliability. The two distribution companies further propose to carry out some intervention measures in pilot project areas – Tema and Tamale respectively. ESIAs will be conducted for the respective proposed work by ECG and NEDCo in view of the comprehensive nature of the activities envisaged.

Some of the salient aspects of the issues to be considered under the ESIAs include (a) consideration of alternatives; (b) scoping; (c) mandatory environmental issues to be addressed; and (d) sector specific issues to be addressed. The ESIAs will be undertaken in line with the Environmental Protection Agency Act, 1994 (Act 490) and the Environmental Assessment Regulations, 1999 (LI 1652); other relevant regulations in Ghana; and the relevant IFC Performance Standards. It is worth noting that the IFC Performance Standards will guide all aspects of the projects, including its design, assessment, and operation.

Cognizance will also be taken of the ESIA prepared for the Ghana Energy Development and Access Project (GEDAP) funded by the African Development Bank and the World Bank; and the ESIA prepared for Distribution System Upgrade Project (DSUP) funded by the World Bank. Since ESIAs will be prepared for the undertakings, the submissions to EPA over a period of time will also include Environmental and Social Management Plans (ESMPs) updates; and Annual Environmental Reports (AERs).

## 3.10 Gender Analysis

There has not been any gender analysis done in the project areas to obtain baseline information for project monitoring and evaluation. Specific baseline studies will be conducted in order to ascertain the specific gender needs of men and women and other vulnerable groups, in the selected communities. To accomplish this, the following will be done:

1. A situational analysis to identify the potential beneficiary communities will be undertaken. It is expected that poor rural communities such as isolated island communities, migrant communities, communities with large numbers of female headed households will be identified. Also large markets in urban areas, rural markets that serve as aggregating points for many rural people, deprived schools, schools with no power from Compact I, community clinics and health posts in poor rural communities will also be identified.
2. In order to promote gender equity and advance poverty reduction, a baseline study of the selected project communities will be done to obtain gender disaggregated data on the different roles and responsibilities of women and men and other social groups in each community. It will also identify the practical and strategic needs of women and men. This analysis will assist in determining how the proposed project will impact positively or negatively on women and men.

## 3.11 Resettlement Action Plans

### 3.11.1 Resettlement

Involuntary resettlement entails both physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project related land acquisition. Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for affected persons and communities, as well as environmental damage and social stress in areas to which they have been displaced[16]. As a result every effort will be made to avoid involuntary resettlement. However, if involuntary resettlement becomes necessary, a comprehensive plan will be prepared as part of the ESIAs.

In line with the IFC Performance Standard on Land Acquisition and Involuntary Resettlement, the objectives that will be set for matters related to resettlement are follows: to,

(i) Avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.

(ii) Minimize adverse social and economic impacts from land acquisition or restrictions on land use.

(iii) Improve, or restore, the livelihoods and standards of living of displaced persons.

Similarly the major requirements that will be taken into account will be in line with IFC Standards and they will be as follows:

[16] IFC Performance Standard 5. Land Acquisition and Involuntary Resettlement.

(i) Avoid involuntary resettlement where possible (see above). Consider feasible alternative project designs to avoid or minimize physical and /or economic displacement.

(ii) Where resettlement is unavoidable carry out a census with socio-economic baseline data to identify the persons who will be displaced by the project, determine who will be eligible for compensation and assistance, and discourage the influx of people ineligible for those benefits.

(iii) Develop appropriate plans to identify and address all affected communities and persons that will be temporarily or permanently displaced either physically (i.e. physical relocation) and/or economically (i.e. loss of income sources or means of livelihood) by the project's risks and impacts.

(iv) Classify displaced persons according to those who (i) have formal legal rights to the land or assets they occupy or use; (ii) do not have formal legal rights to land or assets, but have a claim to land that is recognized or recognizable under national law; or (iii) have no recognizable legal right or claim to the land or assets they occupy or use.

(v) Provide relevant and meaningful information to affected communities and persons throughout all stages of the project. Engage communities in the development of feasible alternatives and /or solutions. Capture the views and concerns of different groups, in manners and forums appropriate to them.

(vi) Encourage the use of negotiated settlements so as to avoid situations that result in forced eviction. Offer displaced persons and communities (a) compensation for loss of assets at replacement cost and (b) assistance, including relocation assistance and transitional support, to improve or at least restore their living standards and livelihoods,

(vii) Compensation standards should be transparent and applied consistently to all communities and persons affected. Offer in-kind compensation in lieu of cash, when appropriate

(viii) Land and /or related assets should only be acquired after the compensation has been made available and, where applicable, resettlement sites, moving allowances, in addition to compensation, have been provided to affected communities and /or persons displaced by the Project. In circumstances where compensation is not feasible before taking possession of the land, compensation funds shall be made available through transparent and agreed upon procedures.

(ix) Establish a grievance mechanism to receive and address specific concerns about compensation and relocation raised by displaced persons or members of the host community. Identify or establish a recourse mechanism for redress and appeal, with sufficient independence and authority to mediate or provide support to affected populations as appropriate.

(x) Establish procedures for monitoring and evaluating resettlement implementation.

### 3.11.2 Right of way

Right-of–Way (RoW) of approximately 5 metres on each side of a distribution line is the approved width for 11kV to 33kV lines. This will apply to construction of distribution lines by ECG and NEDCO in Tema and Tamale respectively. Once the route of the transmission line has been established, the land lying within the RoW will be subject to provisions of the Way leaves laws of Ghana, which prohibit a number of activities in the RoW.

Particular attention will be paid to displacements and compensation related matters. Concerted efforts will be made to avoid the displacement of people as much as possible. Nevertheless implementation of the project may lead to some relocations and temporal disruptions in the use of certain roadways. Where permanent relocations are inevitable, the affected persons will be identified and a compensation plan (Rehabilitation Action Plan or Resettlement Action Plan) will be prepared after consultations with key stakeholders and negotiations with such persons. Compensation payments will then be effected as promptly as possible. Disputes arising from the implementation of the project will therefore be generally averted. Due process, laws, regulations, operational directives, and guidelines (including relevant IFC Performance Standards) will be followed.

## 3.12 Plans for Additional Studies to Develop the Concept Project

To be initiated

# 4 Project Benefits and Beneficiaries

## 4.1 Distribution – ECG (Project 2A)

The MCC cost component of the proposed Tema distribution network intervention is about US$116.9 million. About 2% of the population of Ghana in the Tema area are expected to benefit[17] directly from this intervention with an economic rate of return of about 39%.

The proportion of beneficiaries whose consumption expenditure fall below the US$1.25 and US$2.00 a day poverty line are respectively 5.40 percent and 19.1 percent. We also note that about 42.9 percent of the beneficiaries spend above US$4 a day. The PV of Benefits Stream per beneficiary on the average is US$252 dollars, translating to about 30.69 percent of total annual expenditure of the beneficiary. The PV of Benefit Stream per Project Dollar (USD) in general is US$0.87 for all beneficiaries but this is lower for beneficiaries below $US1.25 and $US2, at US$0.02 and US$0.103 respectively. About 52 percent of beneficiaries in the Tema intervention area are females.

[17] It need to be added that this is a conservative projection as the ECG Tema operational area includes areas outside of the Tema district which have not been included in the estimates here.

**Table 14 – Beneficiary Analysis of the ECG (Tema) Distribution Project (Project 2A)**

| | | | | | |
|---|---|---|---|---|---|
| **MCC Cost (Millions USD)** | **$116.9** | | | | |
| **20-Year ERR** | **39.0%** | | | | |
| **Present Value (PV) of All Costs (Millions PPP $)** | **$61.7** | | | | |
| **PV of Benefit Stream (Millions PPP $)** | **$101.9** | | | | |
| | | **Consumption per day (2005 PPP $)** | | | |
| **Beneficiaries** | **Total** | **< $1.25** | **< $2** [1] | **$2-$4** | **> $4** |
| Beneficiary Households in Year 20 (#) | 191,604 | | | | |
| Beneficiary Individuals in Year 20 (#) | 788,142 | | | | |
| National Population in Year 20 [2] (#) | 42,451,924 | | | | |
| Beneficiary Population by Poverty Level [3](%) | | 5.40% | 19.10% | 38.00% | 42.90% |
| National Population by Poverty Level [3] (%) | | 17.70% | 38.90% | 36.50% | 24.60% |
| **The Magnitude of the Benefits** | | | | | |
| PV of Benefit Stream Per Beneficiary (USD) | $252 | $55 | $80 | $151 | $419 |
| PV of Benefit Stream as Share of Annual Income (%) | 30.69% | 18.14% | 21.48% | 26.82% | 38.22% |
| **Cost Effectiveness** | | | | | |
| PV of Benefit Stream/Project Dollar (USD) | $0.872 | $0.020 | $0.103 | $0.388 | $1.211 |
| **Percent of Project Participants Who Are Female** | 52% | | | | |
| GNI per capita [4] (USD) | $1,571 | | | | |
| Current National Population | 24,658,823 | | | | |

NB: all benefits incremental; PVs based on 22% discount rate and exclude MCC costs but net out any local costs

[1] The beneficiaries and population living on less than $2 per day include those under $1.25 per day

[2] Based on current population estimate, projected to Year 20

[3] Based on GLSS5 estimates, extrapolated to 2011.

[4] See GSS Time series National Income, 2012

## 4.2 Distribution – NEDCo (Project 2B)

The proposed project is expected to contribute to economic growth, poverty reduction, stimulation of private sector growth as well as meeting the targets of the Ghana Shared Growth and Development Agenda (GSGDA). Overall the MCC cost component (excluding administration costs) for this project is about US$57.96 million with an expected economic rate of return of about 12.3% over a 20-year period.

**Table 15 – Beneficiary Analysis of the NEDCo (Tamale) Distribution Project (Project 2B)**

| | | | | | |
|---|---|---|---|---|---|
| **MCC Cost (Millions USD)** | **$58.0** | | | | |
| **20-Year ERR** | **12.3%** | | | | |
| **Present Value (PV) of All Costs (Millions PPP $)** | **$36.1** | | | | |
| **PV of Benefit Stream (Millions PPP $)** | **$22.0** | | | | |
| | | **Consumption per day (2005 PPP $)** | | | |
| **Beneficiaries** | **Total** | **< $1.25** | **< $2** [1] | **$2-$4** | **> $4** |
| Beneficiary Households in Year 20 (#) | 110,800 | | | | |
| Beneficiary Individuals in Year 20 (#) | 696,503 | | | | |
| National Population in Year 20 [2] (#) | 42,451,924 | | | | |
| Beneficiary Population by Poverty Level [3](%) | | 38.70% | 63.60% | 25.70% | 10.70% |
| National Population by Poverty Level [3] (%) | | 17.70% | 38.90% | 36.50% | 24.60% |
| **The Magnitude of the Benefits** | | | | | |
| PV of Benefit Stream Per Beneficiary (USD) | $58.06 | $25.36 | $33.61 | $76.19 | $159.84 |
| PV of Benefit Stream as Share of Annual Income (%) | 21.32% | 17.68% | 18.31% | 22.91% | 35.33% |
| **Cost Effectiveness** | | | | | |
| PV of Benefit Stream/Project Dollar (USD) | $0.38 | $0.118 | $0.257 | $0.235 | $0.206 |
| **Percent of Project Participants Who Are Female** | 50% | | | | |
| GNI per capita [4] (USD) | $1,571 | | | | |
| Current National Population | 24,658,823 | | | | |

NB: all benefits incremental; PVs based on 22% discount rate and exclude MCC costs but net out any local costs

[1] The beneficiaries and population living on less than $2 per day include those under $1.25 per day
[2] Based on current population estimate, projected to Year 20
[3] Based on GLSS5 estimates, extrapolated to 2011.
[4] See GSS Time series National Income, 2012

The table above shows the poverty implications of the NEDCo distribution intervention in Tamale. A large proportion of beneficiaries for this intervention are poor. The proportion of beneficiaries below the US$1.25 and US$2 a day poverty marks are respectively 38.7 percent and 63.6 percent. The proportion of beneficiaries above $US4 a day is only 10.7 percent. The present value of the benefits Stream per beneficiary on the average is $US58.06 dollars - this is about 21.32 percent of the beneficiary's total annual expenditure. A beneficiary below US$2 benefits by about US$33.61 in present value terms - about 18.31 percent of total annual expenditure. The PV of Benefit Stream per

Project Dollar (USD) which measures the cost effectiveness, is in general about US$0.38 dollars. About half of the beneficiaries in this intervention area are females.

## 4.3 Access to Electricity – Isolated Communities (Project 5C)

### 4.3.1 General Assumptions

The assumptions in the calculation of the ERR for this project are namely:

1. the target population is about 0.05% (12,500)of the national population;
2. We assumed the number of extra working hours gained as a result of power to be 2 hours per day and 600 hours a year;
3. we again assume that the number of communities to benefit from this intervention is 50 with each having a population of about 250;
4. the calculation of ERR supposes a period of 20 years, beginning in 2012 until 2032.
5. the population growth of 2.9% is assumed;
6. the total cost of investment, in nominal terms, from MCC is $1.98 USD Million;
7. the Gross Domestic Product per capita per hour for these communities is estimated to be about 50% of that for the country as a whole.
8. these communities gain an extra on average about 2 hours a day for working time as a result of the intervention
9. we again assume the percent of GDP due to power to be 15%;

### 4.3.2 General Outputs

- The ERR for the generation project is 21.1%;
- The NPV of the benefit stream is $1,020,119.03 USD;
- The NPV of the cost is $1,060,661.12 USD.

### 4.3.3 General Outcome

- Based on our assumption, the distribution of income (consumption) for the year 2032 is: 78.7% for those living on less than $ 1.25 USD per day; 92.4% for those less than $2.00 USD per day; 5.1% between $ 2.00 – $ 4.00 USD per day, and finally 2.5% for people with more than $ 4.00 USD per day18;
- The ratio of the present value of the stream of benefits to the cost of the investment is about 19.8. Across the different beneficiary groups it ranges from 19.12 for those living on less than US$2 a day to about 7.61 for those living on more than US$4 a day

[18] Since these communities are relatively poor, we base our projections on the poorest region (UE) poverty data.

**Table 16 – Beneficiary Analysis for Access to Electricity – Isolated Communities (Project 5C)**

| | | | | | |
|---|---|---|---|---|---|
| **MCC Cost (Millions USD)** | **$1.983** | | | | |
| **20-Year ERR** | **21.1%** | | | | |
| **Present Value (PV) of All Costs (Millions PPP $)** | **$1.0** | | | | |
| **PV of Benefit Stream (Millions PPP $)** | **$39.3** | | | | |
| | | **Consumption per day (2005 PPP $)** | | | |
| **Beneficiaries** | **Total** | **< $1.25** | **< $2** [1] | **$2-$4** | **> $4** |
| Beneficiary Households in Year 20 (#) | 5,328 | | | | |
| Beneficiary Individuals in Year 20 (#) | 23,445 | | | | |
| National Population in Year 20 [2] (#) | 42,451,924 | | | | |
| Beneficiary Population by Poverty Level [3](%) | | 78.70% | 92.40% | 5.10% | 2.50% |
| National Population by Poverty Level [3] (%) | | 17.70% | 38.90% | 36.50% | 24.60% |
| **The Magnitude of the Benefits** | | | | | |
| PV of Benefit Stream Per Beneficiary (USD) | $105.16 | $41.39 | $59.05 | $567.39 | $866.45 |
| PV of Benefit Stream as Share of Annual Income (%) | 34.20% | 22.38% | 27.32% | 123.10% | 107.13% |
| **Cost Effectiveness** | | | | | |
| PV of Benefit Stream/Project Dollar (USD) | 19.82 | 11.44 | 19.12 | 10.16 | 7.61 |
| **Percent of Project Participants Who Are Female** | 51% | | | | |
| GNI per capita [4] (USD) | $1,571 | | | | |
| Current National Population | 24,658,823 | | | | |

NB: all benefits incremental; PVs based on 22% discount rate and exclude MCC costs but net out any local costs

[1] The beneficiaries and population living on less than $2 per day include those under $1.25 per day

[2] Based on current population estimate, projected to Year 20

[3] Based on GLSS5 estimates, extrapolated to 2011.

[4] See GSS Time series National Income, 2012

## 4.4 Access to Electricity – Peri-Urban Communities (Project 5B)

### 4.4.1 General Assumptions

The assumptions in the calculation of the ERR for this project are namely:

1. the target population is about 0.4% (100,000)of the national population;
2. We used data from an enterprise survey to arrive at the number of hours of outages which stands as 192 hours a year on the average;
3. we again assume that the percentage of outages that is planned, on average, is about 50%;
4. the calculation of ERR supposes a period of 20 years, beginning in 2012 until 2032.
5. the population growth of 2.5% for the 2010 Census data by Ghana Statistical Service;
6. the total cost of investment, in nominal terms, from MCC is $38.66 USD Million;
7. the Gross Domestic Product per capita per hour is estimated to be $0.67 USD from the GDP statistics as well as our enterprise Survey;
8. we again assume the percent of GDP due to power to be 15%;
9. Commercial and collection loss savings per person is estimated as $9.00 USD[19];

### 4.4.2 General Outputs

- The ERR for the generation project is 9.5%;
- The NPV of the benefit stream is **$17,171,010.00** USD;
- The NPV of the cost is **$38,660,000.00** USD.

### 4.4.3 General Outcome

- Based on our assumption, the distribution of income (consumption) for the year 2032 is: 1.19% for those living on less than $ 1.25 USD per day; 5.62% for those less than $2.00 USD per day; 24.15% between $ 2.00 – $ 4.00 USD per day, and finally 69.64% for people with more than $ 4.00 USD per day;
- The ratio of the PV of benefits stream to the cost of the investment is 0.44 for all beneficiaries. In terms of the different beneficiary groups we note that for those living with less than $ 2.00 USD per day it is 0.014; it is 0.12 for those between $ 2.00 – $ 4.00 USD per day, and 0.84 for those living on more than $ 4.00 USD per day.

[19] This is a weighted average of the Tamale and Tema numbers

**Table 17 – Beneficiary Analysis for Access to Electricity - Peri-Urban Communities (Project 5B)**

| | | | | | |
|---|---|---|---|---|---|
| **MCC Cost (Millions USD)** | **$38.660** | | | | |
| **20-Year ERR** | **9.5%** | | | | |
| **Present Value (PV) of All Costs (Millions PPP $)** | **$38.7** | | | | |
| **PV of Benefit Stream (Millions PPP $)** | **$17.2** | | | | |
| | | **Consumption per day (2005 PPP $)** | | | |
| **Beneficiaries** | **Total** | **< $1.25** | **< $2** [1] | **$2-$4** | **> $4** |
| Beneficiary Households in Year 20 (#) | 39,127 | | | | |
| Beneficiary Individuals in Year 20 (#) | 172,157 | | | | |
| National Population in Year 20 [2] (#) | 42,451,924 | | | | |
| Beneficiary Population by Poverty Level [3] (%) | | 1.19% | 5.62% | 24.15% | 69.64% |
| National Population by Poverty Level [3] (%) | | 17.70% | 38.90% | 36.50% | 24.60% |
| **The Magnitude of the Benefits** | | | | | |
| PV of Benefit Stream Per Beneficiary (USD) | $216.95 | $37.68 | $57.45 | $106.62 | $269.93 |
| PV of Benefit Stream as Share of Annual Income (%) | 30.32% | 20.37% | 26.58% | 23.13% | 33.38% |
| **Cost Effectiveness** | | | | | |
| PV of Benefit Stream/Project Dollar (USD) | 0.44 | 0.002 | 0.014 | 0.115 | 0.837 |
| **Percent of Project Participants Who Are Female** | 51% | | | | |
| GNI per capita [4] (USD) | $1,571 | | | | |
| Current National Population | 24,658,823 | | | | |

NB: all benefits incremental; PVs based on 22% discount rate and exclude MCC costs but net out any local costs

[1] The beneficiaries and population living on less than $2 per day include those under $1.25 per day

[2] Based on current population estimate, projected to Year 20

[3] Based on GLSS5 estimates, extrapolated to 2011.

[4] See GSS Time series National Income, 2012

## 4.5 Access to Electricity – Economic Enclaves (Project 5A)

### 4.5.1 General Assumptions

The assumptions in the calculation of the ERR for this project are namely:

1. the target population is about 0.8% (200,000) of the national population;
2. We used data from an enterprise survey to arrive at the number of hours of outages which stands as 192 hours a year on the average;
3. we again assume that the percentage of outages that is planned, on average, is about 50%;
4. the calculation of ERR supposes a period of 20 years, beginning in 2012 until 2032.
5. the population growth in the economic enclaves is about 1% per year;
6. the total cost of investment, in nominal terms, from MCC is $10.00 USD Million;
7. the Gross Domestic Product per capita per hour is estimated to be $0.67 USD from the GDP statistics as well as our enterprise Survey;
8. we again assume the percent of GDP due to power to be 15%;

### 4.5.2 General Outputs

- The ERR for the generation project is 24%;
- The NPV of the benefit stream is **$37,612,769.18** USD;
- The NPV of the cost is **$10,000,000.00 U**SD.

### 4.5.3 General Outcome

- Based on our assumption, the distribution of income (consumption) for the year 2032 is: 11.2% for those living on less than $ 1.25 USD per day; 31.2% for those less than $2.00 USD per day; 38.9% between $ 2.00 – $ 4.00 USD per day, and finally 29.9% for people with more than $ 4.00 USD per day;
- The ratio of the PV of the benefits stream to the investment costs is about 3.76. By the different classes of beneficiaries this ratio varies from 0.26 for those with income level below US$2 per day to about 3.26 for those living on $ 4.00 USD per day

**Table 18 – Beneficiary Analysis for Access to Electricity – Economic Enclaves (Project 5A)**

| | | | | | |
|---|---|---|---|---|---|
| **MCC Cost (Millions USD)** | **$10.000** | | | | |
| **20-Year ERR** | **23.9%** | | | | |
| **Present Value (PV) of All Costs (Millions PPP $)** | **$10.0** | | | | |
| **PV of Benefit Stream (Millions PPP $)** | **$37.6** | | | | |
| | | **Consumption per day (2005 PPP $)** | | | |
| **Beneficiaries** | **Total** | **< $1.25** | **< $2** [1] | **$2-$4** | **> $4** |
| Beneficiary Households in Year 20 (#) | 56,578 | | | | |
| Beneficiary Individuals in Year 20 (#) | 248,943 | | | | |
| National Population in Year 20 [2] (#) | 42,451,924 | | | | |
| Beneficiary Population by Poverty Level [3](%) | | 11.20% | 31.20 | 38.90 | 29.90 |
| National Population by Poverty Level [3] (%) | | 17.70% | 38.90 | 36.50 | 24.60 |
| **The Magnitude of the Benefits** | | | | | |
| PV of Benefit Stream Per Beneficiary (USD) | $186.96 | $19.90 | 33.88 | 116.77 | 438.01 |
| PV of Benefit Stream as Share of Annual Income (%) | 36.26% | 9.12% | 12.80 | 27.82 | 71.74 |
| **Cost Effectiveness** | | | | | |
| PV of Benefit Stream/Project Dollar (USD) | 3.76 | 0.055 | 0.263 | 1.131 | 3.260 |
| **Percent of Project Participants Who Are Female** | 52% | | | | |
| GNI per capita [4] (USD) | $1,571 | | | | |
| Current National Population | 24,658,823 | | | | |

NB: all benefits incremental; PVs based on 22% discount rate and exclude MCC costs but net out any local costs

[1] The beneficiaries and population living on less than $2 per day include those under $1.25 per day

[2] Based on current population estimate, projected to Year 20

[3] Based on GLSS5 estimates, extrapolated to 2011.

[4] See GSS Time series National Income, 2012

## 4.6 Demand Side Management

The intervention on Demand Side Management project aims to contribute to growth and poverty reduction by helping to improve the efficiency of use of power. This will translate to reduced demand for power as businesses and people will for the same output level require less power. This has a system-wide effect as it reduces the demand growth of the existing 70% of the population that have access to power. This intervention, which is expected to cost US$1.8 million, has an economic rate of return of about 24.7% over a 20-year period.

Of the beneficiaries of this intervention, about 17.7 percent have an expenditure of US$1.25 a day or less and about 38.9 percent of them with a daily expenditure of less than US$2. The proportion of beneficiaries with a daily expenditure of above of $US4 is about 24.6 percent. The average of the present value of the benefits stream for each beneficiary is about US$0.029, which is about 0.033 percent of the beneficiary's expenditure. This tends to vary by the income class of the beneficiary with those with a daily expenditure of less than US$2 getting about US$0.09. About 52 percent of beneficiaries are females.

**Table 19 – Beneficiary Analysis of Demand Side Management (Project4)**

| | | | | | |
|---|---|---|---|---|---|
| **MCC Cost (Millions USD)** | **$1.8** | | | | |
| **20-Year ERR** | **24.7%** | | | | |
| **Present Value (PV) of All Costs (Millions PPP $)** | **$1.0** | | | | |
| **PV of Benefit Stream (Millions PPP $)** | **$1.2** | | | | |
| | | **Consumption per day (2005 PPP $)** | | | |
| **Beneficiaries** | **Total** | **< $1.25** | **< $2** [1] | **$2-$4** | **> $4** |
| Beneficiary Households in Year 20 (#) | 6,594,178 | | | | |
| Beneficiary Individuals in Year 20 (#) | 29,716,347 | | | | |
| National Population in Year 20 [2] (#) | 29,716,347 | | | | |
| Beneficiary Population by Poverty Level [3](%) | | 5.40% | 19.10% | 38.00% | 42.90% |
| National Population by Poverty Level [3] (%) | | 17.70% | 38.90% | 36.50% | 24.60% |
| **The Magnitude of the Benefits** | | | | | |
| PV of Benefit Stream Per Beneficiary (USD) | $0.29 | $0.06 | $0.09 | $0.17 | $0.48 |
| PV of Benefit Stream as Share of Annual Income (%) | 0.033% | 0.020% | 0.023% | 0.029% | 0.042% |
| **Cost Effectiveness** | | | | | |
| PV of Benefit Stream/Project Dollar (USD) | $0.65 | $0.056 | $0.288 | $1.088 | $3.395 |
| **Percent of Project Participants Who Are Female** | 52% | | | | |
| GNI per capita [4] (USD) | $1,571 | | | | |
| Current National Population | 24,658,823 | | | | |

NB: all benefits incremental; PVs based on 22% discount rate and exclude MCC costs but net out any local costs

[1] The beneficiaries and population living on less than $2 per day include those under $1.25 per day

[2] Based on current population estimate, projected to Year 20

[3] Based on GLSS5 estimates, extrapolated to 2011.

[4] See GSS Time series National Income, 2012

# 5 Environmental, Social and Gender Risks and Opportunities

## 5.1 Environmental

Negative environmental impacts of the distribution transmission lines, to be constructed by both ECG and NEDCo, will generally be caused by construction, upgrading, operation and maintenance of the lines. Clearing of vegetation from sites and ROWs and construction of access roads, tower pads, and substations are the primary sources of construction–related impacts. Environmental and Social Management Plan (ESMP) prepared for ECG under the above-mentioned Ghana Energy Development and Access Project (GEDAP) identified some of the potential impacts as noise, dust generation, waste generation, public hazards and occupational health and safety specific to power generation, transmission and distribution, impact on land, and impacts on livelihood and economic activities, and public health[20].

The potential negative impacts identified for this project include, among others, destruction of vegetation, soil erosion; habitat fragmentation or disturbances; increased access to wild lands; runoff and sedimentation from grading for access roads, tower pads and substation facilities; loss of land use and at times population relocation due to placement of towers and substations; induced effects from electromagnetic fields; aesthetic interference; and contamination from hazardous materials such as insulating oils and fuels, chemicals for pole preservation and to a limited extent herbicides for right-of–way vegetation; Wooden utility poles are treated with pesticide preservatives to protect against insects, bacteria, fungi and to prevent rot. The commonly used preservatives in Ghana are: Creosote Pentachlorophenol (PCP) and Chromated Copper Arsenate (CCA).

The environmental and social impacts of this project will mainly be assessed under the following three phases: pre-constructional; constructional; and maintenance. The main activities to be considered during the pre-constructional period will include, among others, planning and design, public consultations, and awareness creation and will have negligible impacts on the environment. Environmental impacts during the constructional and operational periods will however require greater attention.

As stated above construction activities can potentially have adverse impacts on the environment – ecological and social impacts. Electric power sub- transmission lines being linear facilities will also adversely impact on socio-cultural resources. As linear facilities, the impacts of the distribution lines occur mainly within or in the immediate vicinity of the Right of Way (ROW). Displacements and compensation can be issues associated with the construction of sub -transmission lines. Construction activities can also have negative impact on local communities through the impact of an influx of construction workers, which may put pressure on local resources, and affect social structures. The effects of short transmission lines can be localized; however, long transmission lines can have regional effects. Furthermore the magnitude and significance of the impacts increase as the voltage of the line increases, requiring larger supporting structures and ROWs. Operational impacts, such as electromagnetic field effects, also increase[21].

With regard to the maintenance phase, no significant impacts are expected during that phase. ECG and NEDCo maintain substations, transmission and distribution lines on a regular basis. Maintenance

[20] Ghana Energy Development and Access Project - ESMP

[21] World Bank: Environmental Assessment Source Book, Vol.III

crew use tools, trucks, aerial lift trucks, access roads, conductors and other equipment necessary for repairing and maintaining insulators to carry out their operations.

Since the de-commissioning phase is expected two decades later, this phase of the project will be addressed, at a preliminary level, in the provisional Environmental and Social Management Plans (ESMPs) to be prepared as part of the ESIAs.

*Mitigation measures* will be undertaken to minimize the negative impacts associated with the projects. These include, inter alia, utilizing appropriate clearing techniques; maintaining native ground cover beneath the lines; replanting disturbed sites; managing ROW to maximize wildlife benefits; avoiding sensitive areas such as habitats, tourist sites, water bodies, wetlands, important bird habitats. Others include carrying out noise abatement measures during construction; using dust suppression techniques; constructing approved transformer oil containment; adopting strict occupational health and safety measures in line with international best practice; taking visual abatement measures as far as practicable.

Special attention will be paid to the management of hazardous materials such as those mentioned above. With regard to wooden utility poles, treated with pesticide preservatives, the mitigation measures taken will be in accordance with industrial best practice. Fire prevention plans for the projects will be drawn up. Potential fire hazards, due to electrical faults, will be minimized by adhering to technical specifications relevant to electrical safety.

Even though the implementation of the proposed projects will lead to some customer inconveniences when electricity has to be interrupted during project implementation, concerted efforts will be made to minimize such inconveniences.

A more comprehensive assessment of the environmental and social impacts and the mitigating measures to be taken will, among others, be addressed in the ESIAs in accordance with EPA guidelines and IFC Performance Standards in particular.

## 5.2 Social and Gender

Females spend more time on reproductive activities than males. Except for child care, rural women also tend to spend more time on reproductive activities than urban women. This may be due to the fact that urban women are more likely to engage house helps or relatives to assist with reproductive work and also more likely to use labour saving devices such as blenders and washing machines. Engaging in these activities reduces the time available for women especially to manage their businesses as well as time available to search for information and opportunities to improve their businesses to enable them make appreciable income levels and reduce poverty

Good practices from elsewhere show that there are some risks associated to all productive use of electricity. These include low electricity tariffs and service connection fees to consumers, reliability of electricity supply, maintenance costs, social acceptance of electricity, marketing outlets to sell finished products, availability of resource mobilization schemes to support potentially profitable micro and small scale enterprises and construction of feeder roads to open up critical areas for productive use of electricity. From a gender perspective, the above risks put impediment in the way of women and other vulnerable groups from benefiting fully from the productive use of electricity.

Due to the absence of a study specifically on gender and electricity in Ghana, the potential risks that will arise from the project are limited. The few potential risks identified include the possibility of improper handling of the solar panels which is likely to affect their sustainability. It is expected that local people (both men and women) should therefore be involved in the planning and implementation of the project to create a sense of ownership amongst them. They should also be trained to maintain the facility. Since women operators within the energy sector are low, there should be a bias towards women in the selection of the trainees.

To identify clearly the specific risks of the project areas there is the need for a national study on gender and electricity to ascertain the specific potential risks.

The opportunities are that electricity access can give a stimulus to start new businesses and create employment. For instance the availability of reliable electricity in a market place will immensely improve businesses such as food processing, vending, cold store operation, hairdressing, tailoring among others. This is because markets serve as economic enclaves particularly for women and economically poor people. It can also protect the property/assets of poor people as dangerous illegal connections in the market places (that often lead to fire outbreaks and disasters) will be minimised.

Efforts will be made to install solar panels to enhance access to electricity for targeted commercial and domestic use. The major advantage for this project is that the public lighting through the solar system will increase safety and security and increase opportunity for the operation of small businesses of both men and women at night. It will increase long evening hours for food vending, as well as lighting for educational and social activities.

# 6 Project Sustainability

## 6.1 Environmental Sustainability

Various activities will be undertaken with the ultimate aim of attaining environmental sustainability. These will include, inter alia, the conduct of environmental and social assessments, preparation of environmental and social management plans and their implementation. Provisional Environmental and Social Management Plans (ESMPs) will also be prepared as part of the ESIAs. The ESMPs will be updated every two years for implementation. Steps to be taken will be in line with MCC's guidelines for environment and social assessment requiring description of measures that ensure the sustainable use of environmental amenities if a project impacts the natural environment, either through discharge of waste products or extraction of renewable resources such as water, fish, timber, etc. Measures will also be taken to enhance the positive environmental impacts of the project and also promote end-use efficiency and conservation of energy.

## 6.2 Operations and Maintenance – Finance

Loss reduction, network reinforcement and intensification related works will be operated and maintained by ECG and NEDCo as part of their respective networks. Operation and maintenance expenses associated with these related activities will be covered from a portion of incremental revenue obtained as a result of activities.

Neither ECG nor NEDCo receive public funds for operation and maintenance of networks. In Ghana, electricity tariffs include provision for operations and maintenance costs. Electricity tariffs are

subject to reviews by the Public Utilities Regulatory Commission (PURC), the regulatory body mandated based on applications from utilities and discussions with stakeholders.

There is no support from utilities for operation and maintenance of isolated solar lanterns, battery chargers and systems. Individuals and institutional beneficiaries will be expected to fund any operation and maintenance costs. The practice at communities that have benefited from isolated electricity schemes under other programs is for beneficiaries to pay for use of battery chargers and for community to use payments for maintenance of public equipment and infrastructure.

## 6.3 Operations and Maintenance – Institutional

Networks constructed under this concept project will be operated by ECG and NEDCo.

ECG has capacity for operation and maintenance of both existing and envisaged networks.

Institutionally, NEDCo currently operates and maintains its network in most Areas. It however relies on the Ghana Grid Company (GRIDCO) for some technical assistance in the maintenance of some medium voltage equipment.

It is proposed to provide some basic maintenance capacity for solar equipment by providing operations and rudimentary fault finding training to members of beneficiary communities and institutions.

It is proposed to improve operational efficiency within demonstration areas of Tamale for NEDCo and Tema for ECG. This will be done through twinning with personnel from other organisations, changes in operational procedures and introduction of new business systems.

## 6.4 Tariffs and User Fees

Electricity from the national grid and associated services will be paid for based on prevailing tariffs. Electricity tariffs are periodically revised by PURC, the regulatory body. Tariffs, as determined by PURC, are supposed to be cost reflective. However, GOG in some instances may choose to subsidise certain user groups or levels of consumption. Tariffs ought to be adequate for operations and maintenance.

There is no support from utilities for operation and maintenance of isolated solar lanterns, battery chargers and systems. Individuals and institutional beneficiaries will be expected to fund any operations and maintenance costs. The practice at communities that have benefited from isolated electricity schemes under other programs is for beneficiaries to pay for use of battery chargers and to apply funds obtained to maintenance of public equipment and infrastructure.

Users are expected to pay for the electricity services by paying the approved rates for electricity. Meters will be installed at the premises of customers connected to the network. The increased use of prepayment meters for customers to be connected in this project is expected to improve collection efficiency.

## 6.5 Policy, Legal and Regulatory Issues

The key issue is GOG attitude to performance of distribution utilities because this will influence its approach to appointments at board and senior management level. The quality of appointments and criteria for continued tenure influences performance of officials and the organisation as a whole.

GOG policy on timely payment for electricity bills and subsidies significantly affects performance of utilities. It is therefore necessary for there to be a more commercial approach to GOG/ utility financial relations. One way may be to promptly settle future financial obligations and a phased settlement of currently outstanding obligations. On GOG's side, obligations include bills for electricity consumed by ministries, departments and agencies as well GOG subsidies of electricity tariffs.

In order for Tamale and Tema to successfully serve as pilot or demonstration areas, it is necessary that these operational regions be actively supported by the rest of NEDCo and ECG respectively. It may be necessary for the two organisations to change their policies including those on budgeting, authority levels of managers as well as human resources e.g. appointments, disciplinary and reward etc.

It will also be necessary to examine the efficiency with which services are provided by ECG and NEDCo to pilot areas. It is anticipated that ECG will remain responsible for procurement and other services for Tema while NEDCo remains responsible for procurement and other services for Tamale. The quality and availability of materials and equipment provided will influence Tema's performance.

It is expected that the pilot areas will have improved performance including higher profitability as a result of proposed activities. In order to sustain improvements, it may be necessary for parent organisations to authorise higher levels of expenditure in pilot areas than for other areas. The point is that the approach is for other operating areas to improve their performance and not for pilot areas to deteriorate. The higher expenditure may be funded from a portion of improved financial performance of the pilot areas.

One area that will require examination is that of human resource and employee/ industrial relations. As the two pilot areas are reorganised and efficiency/ productivity gains are sought, some contentious issues may arise. For example, it may be determined that some employees are not required due to not having the correct attitude or skills or being of excessive number. It may be necessary to retrain, redeploy or in extreme cases terminate appointments. Head office, GOG and union support will be important. It is particularly important the managers of pilot areas receive all necessary support in matters of discipline.

# 7 Project Results and M&E Methodology/Plan

## 7.1 Summary of Program Logic

Summary of Program Logic may be found in a separate document "M&E Strategy for Ghana's Compact II Program".

## 7.2 Potential Indicators

A list of potential indicators may be found in a separate document "M&E Strategy for Ghana's Compact II Program".

## 7.3 Data Gaps

To be identified.

## 7.4 Impact Evaluation Opportunities

Impact evaluation opportunities are discussed within a separate document "M&E Strategy for Ghana's Compact II Program".

## 7.5 M&E Sources and Reference Documents

To be identified.

# 8 Implementation Arrangements

A possible arrangement for the implementing entity is subject to further discussions between GOG and MCC.

There will be responsibilities for implementation for sector agencies including PURC, EC, ECG and NEDCo. It is envisaged that the Energy Foundation, an NGO, will play a role in demand side management activities. It is anticipated that the Environmental Protection Agency will play a major role in monitoring and reporting on environmental related issues.

## 8.1 Description of Government or Other Entities that would have a Role in Oversight and Implementation of the Concept Project

### 8.1.1 Ministry of Energy

The Ministry of Energy (MOE) has oversight responsibility for the electricity sector. It will therefore act as a representative of GOG during implementation. However, it is not envisaged that MOE will play a daily role in implementation.

MOE has acted as representative of GOG in several projects. It has also played a more direct monitoring role in rural electrification projects. MOE currently relies, to some extent, on personnel seconded from sector institutions such as ECG and VRA.

### 8.1.2 Electricity Company of Ghana

ECG will have an important role to play in the distribution project in Tema as well as in activities related to access improvement within its area of operation.

ECG Tema will be responsible for operation and maintenance of infrastructure provided as part of the Distribution – ECG component. The success of the pilot/ demonstration scheme will depend on the target area receiving necessary support from the rest of ECG.

For timely and successful completion of the project, it is important that some preliminary work be done before compact comes into force. Possible areas will be low voltage network survey and redesign. It may also be useful to have ECG carry out preliminary route surveys for 11kV and 33kV network activities.

ECG has undertaken several World Bank and bilateral funded projects. Some projects were undertaken without assistance from consulting firms. ECG has substantial experience in international procurement. There some concerns about the quality of supervision and project management.

As part of skill transfer and reorientation of attitudes, it is proposed to attach engineers and technicians from ECG to consulting firms that will be responsible for project management.

### 8.1.3 NEDCo

NEDCo will have an important role to play in the distribution project at Tamale as well as in activities related to access improvement within its area of operation.

NEDCo Tamale Area will be responsible for operation and maintenance of infrastructure provided as part of the Distribution – NEDCo component. The success of the pilot/ demonstration scheme will depend on the target area receiving necessary support from the rest of NEDCo and possibly VRA and GridCo.

NEDCo has rather limited experience with project implementation. Its project management needs were previously provided by its parent firm, VRA. The makeup of this concept project necessitates constant interaction with NEDCo in general as well as NEDCo Tamale Area.

NEDCo has stated that its personnel require exposure to good practices. NEDCo's participation in implementation of this concept project will provide some exposure. It is proposed that engineers and technicians from NEDCo be attached to consulting firms that will be responsible for project management.

### 8.1.4 Private Firms

It is possible to obtain services of private consulting firms to manage activities in the concept paper. Ghana's electricity sector has made use of international consultants in the past. These firms sometimes associate with Ghanaian firms in order to be competitive.

## 8.2 Implementation Timeline

To be agreed

## 8.3 Consultations and Accountability

To be identified

## 8.4 Plans for Longer Term Project Activities

Yet to be determined

# 9 Annexes

## 9.1 Sector

National Energy Policy, 2010 – Ministry of Energy

Energy Sector Strategy and Development Plan

Ghana Shared Growth and Development Agenda GSGDA, 2010 – 2013, Volume 1, Policy Framework

## 9.2 Distribution – ECG

Executive Summary; Regional Energy Loss Study – Tema; Electricity Company of Ghana, National Technical and Commercial Loss Study, 2012 – Global Energy Consulting Engineers

State of the Sub-transmission Networks Report as at June 2011 in Urban Centres of the ECG Operational Area – ECG Power System Planning Division

Power Distribution System Master Plan Study for Ghana, July 2008 - Chubu Electric Power Co., Inc.

## 9.3 Distribution – NEDCo

Executive Summary; Regional Energy Loss Study – Tamale; NEDCo, National Technical and Commercial Loss Study, 2012 – Global Energy Consulting Engineers

NEDCo Business Plan 2013 – 2017

Northern Distribution Company (NEDCo) Load Flow Report (Tamale Bulk Supply Point), February 2012

NED Long Term Forecast 2011 – 2021 April 2011, VRA Planning Tamale

Power Distribution System Master Plan Study for Ghana, July 2008 - Chubu Electric Power Co., Inc.