GHANA MILLENNIUM CHALLENGE ACCOUNT PROGRAM

COMPACT II

Powering Ghana for Accelerated and Sustainable Economic Growth

POWER GENERATION CONCEPT PAPER

(PROJECT 3)

SUBMITTED TO

THE MILLENNIUM CHALLENGE CORPORATION

WASHINGTON D.C.

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ABBREVIATIONS

BPA	Bui Power Authority
CENIT	Tema CENIT Thermal Power Project
EC	Energy Commission
ECG	Electricity Company of Ghana
GOG	Government of Ghana
GRIDCo	Ghana Grid Company
IPP	Independent Power Producer
kWh	kilo Watt Hour
LFO	Light Fuel Oil
mmscfd	Million Standard Cubic Feet per Day
MW	Mega Watt or 1,000,000 Watt
NEDCo	Northern Electricity Distribution Company
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PURC	Public Utilities Regulatory Commission
TAPCO	Takoradi Thermal Power Plant
TAQA	Abu Dhabi National Energy Company
TICO	Takoradi International Company
VRA	Volta River Authority
WAGP	West African Gas Pipeline Company
WAPP	West African Power Pool

PROJECT TITLE

1 Project Rationale and Description

1.1 Problem/ Constraint Statement

The electricity sector has been identified as constituting a binding constraint to the national economy. Key issues requiring attention are the low reliability of power supply and insufficient access to electricity. With persistently high load growth combined with limited addition of generation capacity, the margin between generation capacity and maximum demand has reduced substantially. There are times when capacity is not sufficient to meet demand. Generation is contributing more to unreliability of electricity supply.

By adding generation capacity, reliability of generation is expected to increase and the overall reliability of electricity supply is expected to improve. It is thought that increased reliability of electricity supply will improve productivity and profitability of beneficiary businesses.

1.1.1 Local Generation Requirement

Ghana obtains electricity from a mix of hydro and thermal sources. The total available generation capacity is approximately 1,870MW. Taking into consideration planned and unplanned downtimes of the various generating units, especially forced outages and plant unavailability due to fuel shortages, expected generation availability must be computed as 1,485 MW, equivalent to 13,008 GWh. The forecast demand including losses for 2011 was 1,748MW. These figures point to possibility that generation facilities will be unable to meet system demand under certain conditions[1].

The minimum required reserve margin for reliable operation is between 20% and 25%[2]. The figure for 2011 was forecast at about 6.5%[3].

The average growth rate in energy consumption between 2008 and 2010 was 10%[4]. The average growth rate from 1998 to 2008 was 6.2%.

It is estimated that the generation shortfall for Ghana including lack of reserve margin as at the end of 2011 was about 600MW. Over the period 2010 to 2020, required generation has been forecast to increase by between 131-240MW per year (excluding reserve margin) and 157- 288MW per year (including provision for 20% reserve margin)[5]. On-going projects will be capable of providing approximately 450MW of capacity by 2014[6]. It is clear that a generation shortfall exists that will persist for some time.

[1] 2011 Electricity Supply Plan - GRIDCo
[2] Ghana Power Reliability Report – Power Systems Energy Consulting
[3] 2011 Electricity Supply Plan - GRIDCo
[4] 2011 Electricity Supply Plan – GRIDCo
[5] 2011 Electricity Supply Plan, Base Forecast - GRIDCo
[6] Bui Hydro's 400MW peak capacity works out to about 110MW average based on reservoir capacity. Schedule for 360MW expansion of Sunon Asogli is yet to be established due to uncertainty about availability of gas. Sunon Asogli's proposed expansion is not included in 450MW estimate

1.1.2 West African Power Pool (WAPP)

WAPP is an association of the national electricity companies in West Africa under the auspices of the Economic Community of West Africa States (ECOWAS). WAPP members are committed to establishing a reliable power grid for the region and a common market for electricity.

There is a generation deficit in the West African region as a whole. The Infrastructure Consortium for Africa estimates that the West African region will require approximately 18,000MW of additional generation capacity over the next decade [7].

Nigeria has the largest economy in West Africa. In 2010, its average electricity generation capacity available was about 3,500MW against an average electricity demand, as projected by the Energy Commission of Nigeria, of more than 10,000MW[8].

The fluctuating frequency of Nigeria's grid prevents establishment of a stable alternating current interconnection between Ghana's grid and Nigeria's grid. Ghana receives electricity via its interconnection with Ivory Coast. Ghana exports electricity via interconnections with Burkina Faso, Togo and Benin.

With the exception of Ivory Coast, it is unlikely that Ghana will be able to obtain supplementary supplies from WAPP in the medium term. WAPP however is a potential market for future excess generation capacity in Ghana subject to the resolution of technical and financial challenges.

1.1.3 Slow Attraction of Private Capital

It had been hoped to attract private capital to provide the required expansion in generation capacity. There have been several preliminary inquiries from private capital but actual development of private generation capacity has been much less than had been hoped for.

Numerous PPAs have been signed between ECG and prospective IPPs. So far only one entirely privately owned IPP, Sunon Asogli a Chinese venture, is actually generating electricity. TICO, a PPP between TAQA (90%) and VRA (10%), has been operating for over ten years.

A Ghanaian firm, CENIT, is actively developing a 110MW plant. TICO is expanding its existing facility with a 110MW steam unit. Sunon Asogli is interested in expanding its capacity by a reported 360MW. Other generation developments, namely Takoradi 3 and Bui, are 100% government backed.

The main issues of concern to potential developers are

- Government stability and willingness to honour long term commitments
- Access to justice system and expeditious resolution of disputes
- Credible off-taker
- Availability, transparent allocation and pricing of fuel (gas)
- Tariffs

[7] http://www.icafrica.org/en/topics-programmes/west-africa-power-pool/

[8] Prof Sambo, CEO of Nigeria Energy Commission, June 2011 in an interview. - http://www.westafricagateway.org/opinions/interviews/nigerias-energy-challenges. Interview uses MWh but this paper corrected unit to MW.

1.1.4 Credible Off-Taker

A key concern of prospective IPPs is the lack of a credible off-taker. The distribution sector constitutes about 70% of Ghana's electrical load. The size and rapid growth of the distribution load makes it attractive to IPPs as a market. This market may be accessed through the two public distribution companies, ECG and NEDCo. Some prospective IPPs are uncertain of the ability of distribution companies to honour their financial obligations in the long term. GOG has had to provide guarantees for most loans to the power sector. Prospective IPPs desire GOG guarantees to insulate them from risks posed by utilities' poor financial status. GOG is however reluctant to provide guarantees for PPAs. Prospective IPPs have indicated that the need for government backing of PPAs will recede as the financial positions of the distribution utilities improve.

VRA currently has a PPA with TICO that is backed by a sovereign guarantee. ECG's PPA with Sunon Asogli is not backed by a sovereign guarantee.

1.1.5 Tariffs

Prospective IPPs have concerns about the transparency of the tariff setting procedure. This is logical given that local utilities have expressed similar concerns. There are also concerns about delays in approving tariff adjustments to match changes in conditions. Utilities have also expressed concerns about the adequacy of tariffs in relation to legitimate costs. However, PURC publishes its automatic adjustment formulae and its projections for values of parameters used in the formulae. PURC also takes account of stakeholder sentiments and quality of services in setting tariffs.

Tariffs for sale of electricity by IPPs are set within PPAs. The PURC reviews and approves formulae where electricity is destined for the regulated market. Once initial PPA approval is obtained, PURC applies the tariff formula within each PPA (for the regulated market only) to obtain a weighted average to determine the bulk generation charge. PURC does not review tariffs or PPA for the unregulated market.

Prospective IPPs may have generation tariff issues adequately covered in their PPAs. However, the tariff approved for ultimate off-takers i.e. distribution companies is of importance to IPPs because the adequacy of distribution tariff will influence the ability of distribution companies to meet their financial obligations.

Following unbundling of the transmission grid from VRA to form GRIDCo and the entry of IPPs into the sector, Ghana now has the situation of multiple generation players and an independent grid in its market. It is now necessary for the tariff to cater for issues that previously did not matter. These issues are summarised below.

- Capacity charge – Current tariffs and PPAs cater for both capacity and energy as a single charge per kWh of energy generated. There is no way, at present, of rewarding a facility that provides capacity that serves as reserve margin.

- Reactive power – As stated earlier, generation charges are currently based on kWh with no consideration for the reactive power requirements of the grid. Without a pricing mechanism, potential suppliers are not inclined to provide reactive power to meet the needs of the grid.

- Bui Hydro Scheme has a relatively small reservoir and is intended to provide peak power. Tariffs as structured now, do not take into account time of supply or time of use.

VRA and GRIDCo currently provide reactive power without receiving explicit payments for this service.

1.1.6 Fuel Options

Credible fuel options for power generation in Ghana are hydro, gas, fuel oil and diesel.

Major hydro sources are used up. Unutilised identified sites are limited in potential to a maximum of about 100MW. There are supply security issues with the hydro option due to variations in rainfall patterns. Some hydro implementations face environmental challenges due to flooding to form reservoirs.

Fuel oil and diesel have cost disadvantages. Use of heavy fuel oil is also constrained due to environmental reasons.

Ghana does not have coal deposits neither is coal imported in large quantities. Use of coal as a fuel for power generation will require provision of infrastructure for importation and handling. There will also be environmental issues that will need to be addressed.

The preferred fuel for power generation in Ghana is gas for cost and environmental reasons.

1.1.7 Gas Availability, Allocation and Pricing

The only source for gas for power generation at the moment is Nigeria via the West African Gas Pipeline (WAGP). The amount of gas delivered by WAGP is not sufficient for existing thermal plants. Indeed, Sunon Asogli Phase 1 Plant is only able to operate because VRA has transferred part of its WAGP gas allocation to this plant. There are no indications about WAGP's ability to increase the quantity of gas delivered to Ghana.

There are also justifiable concerns about the security, reliability and quality of gas supplies from Nigeria. Instantaneous flow rates of gas have been said to fluctuate significantly about an average figure. There have been occasional shortfalls in delivery of gas via WAGP that contributed to power outages and increased cost of generation.

Discoveries of gas off the coast of Ghana mean that gas will eventually be available for local use. There is a study underway to prepare a gas master plan. In the interim, GOG has repeatedly stated that power generation will have highest priority in allocation of local gas.

IPPs, both prospective and operating, have expressed concerns about the need to institute transparent pricing and allocation procedures.

Lack of confidence in availability of gas will delay implementation of some generation projects. Sunon Asogli is delaying an expansion project until it is certain of allocation of gas.

Insufficient gas supplies may result in tariff increases because some generation facilities with multiple fuel capability will switch to more expensive fuels in order to maintain electricity supply. Thermal generation plants with multiple fuel capability will have higher capital costs. It will therefore be desirable that such plants, if considered to be necessary for supply security, be compensated for

higher capital and operational costs. PPAs may specify what an IPP ought to be paid for using a substitute fuel if the primary fuel is not available. However, it then becomes necessary for distribution utilities to be able to recover any cost increases that they may incur as a result of changes in fuel.

Gas shortages may also lead to shortages of electricity because some plants can only utilise gas as a fuel.

1.1.8 Gas Infrastructure

The Gas Infrastructure Project involves receiving gas from the oil and gas fields in the Tano (Western) Basin and processing it into lean gas, propane, butane and condensate. The associated raw gas production profile from the Jubilee Field development plan estimates a maximum 120 mmscfd for the initial phase. This is expected to be maintained over a three year period. Besides Jubilee, a number of additional discoveries of oil and gas have been made in the Western Basin offshore Ghana. Some of the discoveries, such as the Sankofa, Dzata, Tweneboa as well as the North and South Tano fields, have significant gas component. The raw gas from the new developments will also be exported to shore where it will be processed in a new green-field processing plant to produce lean gas, propane, butane, LPG and condensate. For the initial phase of the gas commercialization project, the lean gas will be transported eastwards as feed fuel for the existing power plant in Aboadze, near Takoradi[9].

An issue with the above plan is that there will be a period within which there will be insufficient gas to supply the power generation market. There is a study underway to investigate the feasibility of an LNG terminal and regasification plant. Such a facility will be required to provide security of supply to back up both WAGP and local gas supplies.

1.1.9 Competitive Access to Electricity Market

The largest market segment for electricity is the public distribution sector served by ECG and NEDCo, both GOG owned. It is important to prospective IPPs that they have a fair and competitive access to this sector.

NEDCo, much smaller than ECG, is currently a subsidiary of VRA and supported financially by VRA. The issue of procurement of electricity is therefore not yet important with respect to NEDCo.

PPAs between prospective IPPs and ECG have been developed as a result of negotiation processes rather than through tendering process. Negotiated processes may not necessarily be transparent or give value for money. The process may also place a high burden on prospective IPPs. ECG, with about 90% of the distribution market, ought to consider using competitive procedures for procuring electricity. In the current situation, it is not clear how all prospective IPPs may be assured of a fair chance to access the public market.

The Energy Commission (EC) has developed an outline procedure for competitive procurement of electricity supplies by bulk customers, including distribution companies. ECG made attempts to develop the necessary inquiry document but the competitive approach has never been used.

The EC has also developed a standard PPA that does not appear to have ever been used.

[9] http://ghanagas.com.gh/pages/ongoing_projects.html

1.1.10 Cumbersome Development Process

Non-core costs associated with generation projects can be substantial. Currently, prospective IPPs are faced with the prospect of dealing with multiple regulatory agencies and handling all aspects of developing green-field sites.

Obtaining clear title to land is sometimes difficult and fraught with legal challenges.

In a situation of uncoordinated development of generation facilities, each prospective IPP is faced with the challenge of developing from scratch, all or most of fixed facilities required to support its operations even if facilities are relatively minor or infrequently used. In Ghana, it is considered advantageous for supply security reasons for generation plant to be dual fuel capable, gas as main fuel and LFO as backup. This implies the need for a gas pipeline to the site, fuel tanker mooring facility to receive fuel from an offshore tanker, fuel pipeline to site and fuel storage to serve the site. The costs are punitively high for small capacity plant. However, where there is a cluster of generating plants in a locality, it becomes possible for them to share some facilities and costs.

1.1.11 Maintenance

VRA has successfully operated and maintained hydro schemes at Akosombo and Kpong for several decades. It has undertaken major retrofit exercises including replacement of turbines and ancillary equipment e.g. protection and control equipment. Maintenance of thermal plants is a relatively new and more difficult area for VRA. Initially, VRA handled maintenance of the TAPCO plant in-house. It has now outsourced maintenance of the TAPCO plant and this has resulted in improvements of availability of TAPCO. Maintenance constraints arise out of VRA's financial difficulties leading to insufficient funds for maintenance.

GE is responsible for maintenance of the TICO plant. Availability of the TICO plant is better than that of the TAPCO plant. It is not known what Sunon Asogli's approach is to maintenance of its plant.

Table 1 shows availability factors for the various generation plant based on assumption that fuel is not a constraint.

Table 1 – Availability of Generation Plant[10]

Plant	Available Capacity (MW)	2010 Actual Availability (%)	2011 Forecast Availability (%)
Akosombo Hydroelectric Plant	960	96.87	94
Kpong Hydroelectric Plant	140	98.55	90
Takoradi Thermal Power Plant-T1 (TAPCO)	200	52.14	70
Takoradi Thermal Power Plant-T2 (TICO)	200	91.6	80
Tema Thermal Power Plant-T1 (TT1PP)	100	93.69	85
Mines Reserve Plant (MRP)	40	69.46	75
Tema Thermal Power Plant-T2 (TT2PP)	45	73.1	85
Sunon Asogli Power Plant (SAPP)	180	-	68

Table 2 – Equivalent Availability Factors (EAF) for different types of generation plant[11]

Plant Type	Weighted Average Equivalent Availability Factor (EAF) in 2009 in North America
Combustion Turbines (All MW sizes, liquid and gas)	91.71
Combined Cycle (All MW sizes)	88.23
Hydro	86.25

[10] 2011 Electricity Supply Plan - GRIDCo

[11] Performance of Generating Plant: New Metrics for Industry in Transition – World Energy Council, London. www.worldenergy.org - 2010

1.1.12 Renewable Energy

The approach used in Ghana's electrification efforts was to prioritise electrification of larger communities as well as communities within a certain distance of existing networks. The pool of un-electrified communities consists of a large proportion of small communities and communities that are relatively far from electricity networks.

Longer distances to supply un-electrified areas combined with low load densities of target areas result in high cost to benefit ratio of electrification when supply is done from the grid. In such situations, off-grid renewable options may offer lower cost alternatives for supply of electricity.

The increase in the thermal generation as a proportion of total energy generated has increased exposure to the risk of fuel price escalations, fuel supply risks (in the case of pipeline gas) and increased the carbon footprint of electricity generated in Ghana.

Act 832, Renewable Energy Act, 2011, requires electricity distribution utilities to procure a percentage of electricity requirements from renewable sources. Terms, percentages and feed in tariff have not yet been finalised.

There is limited local expertise in the development and operation of large scale renewable electricity facilities. There is however some capacity for assembly and distribution of small scale appliances such as solar lanterns.

Issues of concern with use of wind energy include intermittence, difficulties in integration with grid and challenges with forecasting of wind conditions. Issues of concern with use of photo-voltaic energy include intermittence, grid integration difficulties and weather dependence.

1.2 Desired Long Term Sector Objectives

The vision for the electricity sector is to develop an "Energy Economy" that would 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.[12]

Activities proposed under this Concept Paper will assist in meeting energy sector objectives as listed below:

- Support the modernisation and expansion of energy infrastructure to meet growing demands and ensure reliability;
- Promote and encourage private sector participation in the energy sector.

1.3 Expected Project Outcomes

Completion of the power park associated with the project will lower barriers to entry of prospective IPPs. It is therefore expected that the power park will contribute to increasing rate of entry of IPPs into Ghana.

[12] National Energy Policy, Ministry of Energy, February 2010

1.4 Description of Project Outputs and Specific Activities

1.4.1 Gas to Power Park

It is proposed to develop a gas to power park capable of housing three sets of generation plant. The location of proposed site is yet to be determined. Park will be provided with a gas connection, electricity switchyard, and access roads.

1.5 Estimated Cost

1.5.1 Gas to Power Park

Table 3 – Preliminary Cost Estimates for Gas to Power Park

Item Description	**Cost in US$ Million**
Development Activities	14.00
Land Acquisition/Preparatory works	16.00
Gas Pipeline	20.00
Power Evacuation	25.00
Mini Harbour/ Roads	20.00
Total	**95.00**

The costs in the above schedule are extremely tentative. They will be refined following engineering studies.

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 supply 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.

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.

2.1.3 Selection of Concept Projects

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 but 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.

[13] Ghana Shared Growth and Development Agenda (GSGDA), 2010 – 2013

The study estimated the overall cost of the power constraint to the economy at about 5.6 % of GDP.

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'.

Analysis by stakeholders of the cause – effect relations relating to the issue of "inadequate and unreliable supply of electric power" resulted in identification of "inadequate power supply to meet demand" as a key node. The causes of this problem were divided into four groups under the following titles:

- Inefficient use of energy
- Insufficient amount of power generated
- Losses reduce amount of electricity available
- Inefficient use of installed capacity

"Inefficient use of energy" is related to inefficiencies at utilisation level. These issues are partly addressed by demand side activities under the Distribution Concept Paper.

"Insufficient amount of power generated" relates to the slow pace of development of generation. Several of root causes are tackled as part of concept papers on Governance and Regulatory Issues as well as Improvement of Financial Performance of Utilities. Activities in this paper are intended to help address the problem of insufficient generation.

"Losses reduce amount of electricity available" refers to the high level of technical losses incurred in transmission and distribution of electricity. GRIDCo is addressing transmission losses under various activities outside Compact II. Reduction of technical losses at the distribution level is obtained in some activities under the Distribution Concept Paper.

This concept project was selected partly based on comments made by prospective developers of generation facilities during the consultation process.

2.1.4 Government Strategies for Development of the Sector

The policy direction is to increase installed generation capacity from about 2,000MW to 5,000MW in the medium term. Government proposes to achieve the objective by the following:

- Seek financing from the private sector for the rehabilitation and expansion of existing plant;
- Complete the construction of on-going power projects, and
- Encourage private sector investment in the construction and ownership of additional thermal plants.
- Support the development of small and medium scale hydro power projects

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 development programs.

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 most recent reform activity has been decoupling of the national grid from VRA in order to form GRIDCo as a separate entity. The purpose of this activity was to assure prospective IPPs of fair access to the national grid.

2.1.6 Links with Other Concept Papers

This concept project works together with "Improving Financial Performance of Utilities" and "Regulatory and Governance" concept projects in attracting private capital to establish generation plants.

2.2 Description of Recent, Ongoing or Expected Investments in the Sector

2.2.1 Generation

ITEM	PROJECT	BRIEF DESCRIPTION	DURATION	FINANCIER	CURRENCY	AMOUNT	STATUS
	Takoradi 3	132MW combined cycle unit powered by LCO/ Gas and diesel					On-going
	TICO Expansion	Addition of 110MW steam unit					On-going
	Tema Osonor Plant (CENIT)	110MW simple cycle unit powered by LCO/ Gas and diesel					On-going
	Bui Hydro Scheme	400MW capacity facility with approx. 969GWh/year average output.					On-going

3 Inventory of Existing Preparatory Work

3.1 Sector Studies/ Plans

3.1.1 Generation

Ghana Wholesale Power Reliability Assessment 2010 by Power Systems Energy Consulting (PSEC).

Generation Master Plan Study for Ghana – November 2011.

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 regional 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

There has not been any study on gender and electricity generation in Ghana. It is proposed that a national study be done.

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

The Environmental Protection Agency Act, 1994 (Act 490) and the Environmental Assessment Regulations, 1999 (LI 1652), make Environmental and Social Impact Assessment (ESIA) mandatory for the following[14]:

(i) All natural gas fired gas turbine power plants with installed capacity exceeding 500 kVA.

(ii) Combined Heat and Power (CHP) plant with minimum electrical output equal to or exceeding 15 MVA.

(iii) Liquefied Petroleum Gas (LPG) fired electric power plant with installed capacity equal to or exceeding 500 kVA.

(iv) Distributed or array of LPG power plants within 100 metre radius with total installed capacity equal to or exceeding 500 kVA.

(v) Natural gas fired electric power plant with installed capacity equal to or exceeding 500 kVA.

(vi) Distributed or array of natural gas power plants within 100 metre radius with total installed capacity equal to or exceeding 500 kVA.

(vii) Applicable also to all cases of retrofitting or upgrading as well as decommissioning of the stated or described plants.

ESIA is also mandatory for construction of offshore/ onshore oil and gas pipelines. Some of the salient aspects of the issues to be considered under the ESIA include (a) consideration of alternatives; (b) scoping; (c) mandatory environmental issues to be addressed; and (d) sector specific issues to be addressed. The following is mandatory for all new undertakings: (i) ecological impact assessment; (ii) environmental health impact assessment; (iii) hazard and risk impact assessment; (iv) noise impact assessment; (v) social impact assessment; (vi) water quality impact assessment; (vii) air quality impact assessment; (viii) proposed mitigation measures; (ix) assessment of legal and regulatory framework; (x) public consultation and disclosure. In addition to these the project will address relevant sector specific issues in accordance with EPA and or other international guidelines such as IFC Performance Standards, and World Bank Social and Environmental Impact Assessment guidelines.

3.9.1 Consideration of alternatives

Prior to the selection of the various components of the proposed project, various alternatives will be considered regarding alternative sites for the proposed development, alternative designs or techniques which will lead to reduced risks. The alternatives addressed at the scoping stage will include the following, among others: (a) No development scenario; (b) fuel type options; (c) site selection options for the gas power park; (d) alternate plant types; (e) mode of transmission: (f) selection of optimal transmission line route; (g) alternative phase conductors; (h) alternative tower design. These and the resulting decisions taken will be used, inter alia, to inform the preparation of an updated scoping report and terms of reference.

[14] Environmental Impact Assessment for the Energy Sector Vol. 1

3.10 Gender Analysis

It is important to note the constraints and challenges in ensuring social and gender integration in the energy sector and also the good practices in the productive use of electricity and how these impact on the socio-economic lives of the poor particularly poor rural women. Energy is a prime ingredient in all productive, subsistence and leisure activities. The quantity and quality of available energy determines the efficiency and effectiveness of activities, as well as the quality of life of the users. Both male and female members of society are equal stakeholders in benefiting from energy use. But women and men do not benefit equally from access to energy. The same energy service may indeed impact on men and women differently, with different social or economic outcomes. Whilst national development plans often give some focus and attention to energy, little attention is paid to the linkage between gender and energy particularly in the area of implementation. Ghana is no different from other countries in this respect.

Ghana has an energy policy and one of the goals outlined in the policy is to integrate gender in the Energy Sector. The Gender Assessment of the Energy Sector Report (2010) highlights major challenges of the gender integration process as follows:

- 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
- Inadequate stakeholder consultation in program and policy development.
- Lack of personnel and gender experts within the energy sector due to lack of training in gender and non-commitment of financial resources.
- No budget for gender integration activities.
- Limited involvement of women in the planning and management of energy services at national, regional and district levels.
- Limited capacity of women in management positions in the Energy Sector

A comprehensive gender analysis will be done after the identification of proposed project. This is to ascertain how power generation affects positively or negatively the livelihoods of women, men and other vulnerable social groups.

3.11 Resettlement Action Plans

3.11.1 Resettlements

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[15]. 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.

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

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:

(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

RoW of approximately 30 meters (15 meters on either side of the tower) is the approved width in Ghana for a161kV High Transmission line. Tower corridor access tracks of approximately 3.5m – 5m wide (i.e. sufficient width for construction and subsequent maintenance traffic) will also be constructed almost continuously along the centre line of the line route.

The total land take along the entire stretch of associated transmission lines will be secured for the RoW. 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, including mining, construction of buildings and cultivation or farming. Due process, laws, regulations, operational directives, and guidelines will be followed.

Particular attention will therefore be paid to displacements and compensation related matters. Concerted effort will be made to avoid the displacement of people as much as possible. Nevertheless implementation of the project may also 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.

3.12 Plans for Additional Studies to Develop the Concept Project

To be initiated

4 Project Benefits and Beneficiaries

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). The project will contribute positively to sustainable development efforts in Ghana and to the implementation of the GSGDA.

The MCC cost component for this intervention is about US$95million over the 5-year period. This is expected to yield a ERR of about 18% over a 20-year period. This project which should result in increased generation is expected to benefit the entire country.

Table 4 – Beneficiary Analysis of the Power Park Activity under Enabling Environment for Private Investment Project (Project 3)

MCC Cost (Millions USD)	**$95.0**				
20-Year ERR	**18.1%**				
Present Value (PV) of All Costs (Millions PPP $)	**$53.2**				
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 (#)	9,420,254				
Beneficiary Individuals in Year 20 (#)	42,451,924				
National Population in Year 20 [2] (#)	42,451,924				
Beneficiary Population by Poverty Level [3](%)		17.70%	38.90%	36.50%	24.60%
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)	$1.53	$0.57	$0.73	$1.28	$3.18
PV of Benefit Stream as Share of Annual Income (%)	0.33%	0.30%	0.28%	0.30%	0.46%
Cost Effectiveness					
PV of Benefit Stream/Project Dollar (USD)	$0.41	$0.045	$0.126	$0.209	$0.350
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

Above is a scorecard showing the poverty implications of the generation intervention. The entire country will benefit from increased generation and so the poverty profile of the beneficiaries is essentially the same as that for the country as a whole. The proportion of beneficiaries below the $US1.25 a day poverty mark is 17.7 percent and this increases to 38.9 percent when the poverty line is moved to US$2. Of the beneficiaries, those whose consumption exceeds US$4 a day is about 24.6 percent. In terms of the magnitude of benefits, the PV of Benefits Stream per beneficiary on the average is about US$1.53 dollars and this is about 0.33 percent of the average beneficiary's total annual expenditure. The representative beneficiary below US$2 benefits by US$0.73 which is also about 0.28 percent of his/her annual expenditure. In terms of cost effectiveness, the present value of benefit stream per Project Dollar (USD) in general is US$0.41 dollars but this is lower for beneficiaries below US$2 at about US$0.13 dollars. About 51 percent of beneficiaries are females.

5 Environmental, Social and Gender Risks and Opportunities

5.1 Environmental

The potential impacts associated with each focus area will again be qualitatively, and where possible, quantitatively determined and evaluated under the four phases of the project cycle: pre-constructional, constructional, operational and decommissioning phases. An evaluation of the residual, i.e. remaining, impacts after implementation of the mitigation measures will also be undertaken. Following the evaluation of the impacts, measures will be taken to avoid, minimize and or mitigate the potential environmental impacts that could result from the various phases of the project cycle. It is noteworthy that the potential impacts associated with the operational phase will be more dominant. Fossil fuel- fired thermal plants are generally characterized by emissions of greenhouse gases (GHG), acidic gaseous pollutants mainly NO_x, and SO_x, as well as carbon monoxide (CO), and particulates. Acidic emissions lead to acidification of water bodies and soils and consequently cause reduction in fisheries, agriculture and forestry produce. Noise pollution and direct surface water contamination are also some of the adverse impacts. Impacts from solid and liquid wastes from scrubbing and thermal discharges are also notable. Furthermore direct health effects due to the emission of pollutants are potential impacts[16].

Mitigation measures for such plants include, among others: the use of scrubbing technologies; installation of attenuators to reduce noise levels; lessening thermal discharges through utilizing combined cycles plants to generate additional power; installation of appropriate screens at water intakes. It is expected that the site(s) will have adequate supply of water for cooling and good wind dispersion. Ecologically sensitive areas will be avoided.

5.2 Social and Gender

The opportunity for power generation is that more poor and isolated communities and household will have access to reliable electricity. This will increase their economic, social, safety and security issues. This will have a positive impact on their lifestyle and well-being.

There may however be the risks of displacements of families and households during the generation cycle. Studies will be conducted to ascertain the different impacts on the different households from a gender perspective. The SGA Team will be involved in the community selection and consultation.

[16] *Ghana EPA: Environmental Impact Assessment guidelines for the energy sector*, Vol. II

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

Funding of operations and maintenance of the power park is yet to be worked out. The most likely source is some form of ground rent or service charge to be paid by occupants of the site. It is not intended to apply public funds to this purpose.

6.3 Operations and Maintenance – Institutional

It has not yet been decided which institution is to be responsible for operation of the power park.

6.4 Tariffs and User Fees

The structure of tariffs and user fees relating to the power park has not been determined. However, one possible approach is some form of ground rent or service charge.

6.5 Policy, Legal and Regulatory Issues

To be developed

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 may be responsibilities for implementation for Ghana Gas Company. 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 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 of 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 Generation and Transmission

2011 Electricity Supply Plan – GRIDCo

Ghana Wholesale Power Reliability Assessment 2010 by Power Systems Energy Consulting (PSEC)

Generation Master Plan Study for Ghana by Tractebel Engineering – Nov 2011