ENERGY COMMISSION, GHANA

2013 ENERGY (SUPPLY AND DEMAND) OUTLOOK FOR GHANA

Final

April, 2013

Executive Summary

Energy Commission presents supply and demand forecasts for electricity, crude oil, petroleum products, natural gas and charcoal for the year 2013.

Electricity:

In 2012, the total grid electricity generated[1] in the country was 12,164 Gigawatt-hours (GWh)[2].

For 2013, the total electricity requirement of the country would be in the range of 13,667-15,794 GWh. The low-side represents relatively low supply due to comparatively high cost of energy as a result of lower than expected flow of gas for power generation. The high-side covers VALCO operating at two-to-three potlines. Between 13,459-16,121 GWh could be supplied by the public utilities through the national grid depending upon adequate fuel supply for power generation. The low-side represents relatively high cost of fuel or inadequate gas supply.

In 2012, Ghana's peak load on the transmission grid was 1,729 Megawatts (MW) and the total peak on the overall grid system was 1,871 MW.

For 2013, Ghana's peak load and the total system peak on the grid transmission system would be about 1,800 MW and 1,900 MW respectively. For VALCO to be operating between 3-4 potlines, Ghana's peak load and the total system peak would increase to 1,980 MW and 2,500 MW respectively.

Except for the limitations placed on VALCO operations, there should be no significant shortfall in electricity supply to meet demand provided there is adequate supply of fuel for power generation. In summary, installed capacity would not be the challenge but fuel supply is the constraint.

Shortfall in fuel supply would compel the utilities to continue to ration power by resorting to load-shedding. Large consumers however meet their electricity supply shortfall by private and back-up generation at the point of use, or cut down or suspend operations during load-shedding hours.

[1] i.e. electricity generated by the state utilities and the Independent Power Producers and pumped into the grid.
[2] Million units of electricity.

Higher than expected average annual precipitation is expected this year – 2013, according to the Ghana Meteorological Agency (GMA). Higher inflows into the hydropower reservoir would improve the overall power generation to offset inadequate or delayed gas supply.

Natural gas

In 2012, total natural gas required to run all the dual-fuelled thermal plants in optimum mode was about 180 million standard cubic feet per day (mmscfd). However, only an average of 65 mmscfd was available, in consonance with our forecast for that year. WAGP gas flow was truncated in August 2012, due to an accident on the undersea-pipeline in the Togolese waters that very month[3].

For 2013, the average annual volume of natural gas expected from the West Africa Gas Pipeline (WAGP) is likely to reduce further to about 35-40 mmscfd (35,000-40,000 MMBtu)[4], due to technical and demand challenges being encountered in Nigeria. However, domestic gas from the Jubilee field is likely to ramp the annual average up to 45-50 mmscfd by end of the year[5].

2013 is also expected to see commencement of development of other fields neighbouring Jubilee, namely Sankofa, TEN, Sankofa East which are expected to bring along more associated gas by 2017-2018 depending upon the timely and rate of the development of the fields. These new fields are projected to yield an average ranging from 100-500 mmscfd by 2020.

However, considering the number of thermal power plants currently installed and expected to be in operation by 2015, those under construction and those planned or issued with licences by the Energy Commission, estimated total gas requirement is expected to exceed 800 mmscfd by 2017. Thus the only cost effective gas supply option is to import LNG to meet the shortfall, but such an arrangement must start this year-2013 to avert the future anticipated shortfall.

[3] WAGP gas supply was interrupted at the end of August, 2012 following pirate activities in the Togolese waters that month. Since then, gas has not flowed to Ghana at the time of producing this document.
[4] For WAGP gas from Nigeria, assume 1 mscf=1000 MMBtu
[5] Jubilee gas is expected to be available at the end of the year. Assuming at least two month supply from say November to December at the average rate of 70-80 mmscfd will yield an annual average range of 6-10 mmscfd.

In 2012, the WAPCo[6] tariff for transporting natural gas via the West African Gas Pipeline (WAGP) was $4.175 per MMBtu ($4.25 per mscf) and the average WAGP gas price was $2.587 per MMBtu ($2.63 per mscf). Total delivered gas price[7] was $8.188 per MMBtu ($8.34 per mscf).

For 2013, the new WAPCo tariff for transporting natural gas is expected between $4.20-4.30 per MMBtu ($4.28-4.38 per mscf); less than one percent rise over last year. The average WAGP gas price would be within $2.58-2.60 per MMBtu ($2.60-2.65 per mscf). The total delivered gas price would be $8.50-9.00 per MMBtu ($8.66-9.17 per mscf); 3-4% increment over the previous year.

Petroleum

For 2013, the average purchase price of Brent crude would be between $108 and $110 per barrel and $98-102 per barrel for other brands of light crudes. Average light crude oil price for power generation would range from $100-102 per barrel.

Ghana bought Brent crude at an average price of $113 per barrel in 2012. Thus average price is expected to be lower in 2013 by 3-4%.

For 2013, we estimate that the total crude oil and imported products required would increase to 3.0-3.5 million tonnes from 2.9 million tonnes in 2012, in order to meet optimal refinery operations and imported products for local consumption.

Crude oil required for refinery operations would vary from 1.6-1.9 million tonnes (12-13 million barrels) during the year, depending upon the availability of the Tema Oil Refinery and its auxiliary units. The remaining 1.4-1.6 million tonnes of products would have to be imported.

For LPG, the total national requirement could likely be in the range of 250,000-300,000 tonnes for the year due to the growing demand, particularly as transport fuel. However, limited nation-wide storage capacity and the inadequate revenues generated from its sales due to cross-subsidization could continue to constrain supply to 220,000-250,000 tonnes range in 2013.

[6] West African Gas Pipeline Company Ltd.
[7] i.e. including duties, taxes, etc

The breakdown of the total petroleum products required would be as follows:

Product	National supply requirement	Exports included
	Tonnes	
Total Gasoline[8]*	850,000 - 970,000	1,000,000
Total Diesel	1,600,000 - 1,700,000	1,850,000
Kerosene/ATK	200,000 - 230,000	300,000
LPG	250,000 - 300,000	350,000
Total	**3,000,000 - 3,200,000**	**3,500,000**

Crude oil production from the Jubilee field increased from an annual average of about 73,000 barrels per day in 2011 to an annual average of 81,000 barrels per day in 2012, though still short of the target of 120,000 barrels per day projected by the field operators for last year. Production however ramped up to 100,000 barrels per day during the last quarter of 2012.

With technical challenges almost resolved, according to Tullow Oil, the operator,[9],, production is likely to range between 100,000-120,000 barrels per day in 2013.

Charcoal

Average prices of charcoal in the country rose from GH¢9 per mini bag and GH¢15 per maxi bag in 2011 to GH¢11 per mini bag and GH¢18 per maxi bag in 2012.

The high-price regions for 2012 were Western and Central.

The low-price regions were Ashanti, Brong-Ahafo and Northern. , the latter also saw a drop in average mini-bag charcoal price.

[8] NB: *Total gasoline includes Premix; **Total diesel includes supplies to the mining companies and bunkering
[9] According to the operator, Tullow Oil plc, Tullow January 2012 Update.

Averages prices however dropped in Greater Accra for maxi bag and in Northern Region for mini bag.

Average charcoal price for minibag more than doubled in Upper East and West Regions. Eastern and Western Regions also experienced significant charcoal price increment.

We estimate that average charcoal price in 2013 could range between 20-25% over 2012 average price nationwide due to general increase in LPG price, an alternative but cleaner cooking fuel. Increases could go up between 30-35% on the average in the southern sector due to LPG supply shortages and further expected rise in transportation and labour costs.

Recommendations

To ameliorate the overall power supply shortage prevailing in the country, emanating out of inadequate fuel supply for power generation, investments in alternative gas supply in the light of increasing crude oil prices should highly be encouraged. It is therefore commendable for the Ministry of Energy to charge the Energy Commission to coordinate all potential liquefied natural gas (LNG) investment initiatives taking place in the country.

In the light of the above, we reiterate the following recommendations made in 2012:

i. *The power generation utilities supported by the Government should look for alternative sources of natural gas for the country's power plants, besides supplies from the West African Gas Pipeline to enhance gas supply security.*

ii. *In this respect, Government should proactively create incentives to encourage investment in LNG regas facility built in the shortest possible time. An investment workshop for stakeholders where the government entities including Ghana Investment Promotion Centre and the Ministries of Energy and Finance can table the economic and investment incentives that the government could offer would be very essential.*

iii. *The Government should do whatever it could to support the entities concerned including the Ghana National Gas Company Ltd to expedite development of the natural gas processing plant to process gas expected from the offshore Jubilee oil fields. Since the thermal plants are now the marginal generators, natural gas, which is largely less expensive than LCO will help supplement oil-based generation and consequently reduce average generation cost.*

iv. *Government ensures as a matter of urgency, that the required commercial frameworks for the developments of the TEN and the Sankofa fields are finalized by close of this year – 2013 to enable commercial production in these fields to commence by 2017.*

v. *Government provides significant attractive fiscal incentives to investors like tax holidays to make the non-associate gas fields economically viable to develop.*

vi. *On the other hand, Renewable Energy technologies can provide at least 5% of the country's electricity requirements at present. Thus, with the passage of the Renewable Energy Act, 2011 (Act 832), the Energy Commission with the mandate to promote renewable energy in the country and with the support of the sector ministry would team up with the finance and the environment ministries, other stakeholders such as the Environmental Protection Agency, Ghana Investment Promotion Centre, the international, regional and local financial institutions to organise investment fora on assessing carbon finance facilities for grid–connected Renewable energy based power supply in the country.*

vii. *As part of the strategic oil stock of the country, BOST[10] should initiate steps to include storage of crude oil as soon as possible. Storing crude oil is cheaper, stable and more durable compared to storage of products.*

viii. *The sector Ministry, National Petroleum Authority, BOST, Energy Commission and the Ghana Investment Promotion Centre assemble other key stakeholders to identify the key barriers impeding investment in new oil refinery in the country and to institute the needed incentives, to encourage construction of new oil refineries to serve both the local and export markets.*

ix. *National Petroleum Authority should encourage the Oil Marketing Companies to set up more LPG distribution centres to increase access and consumption.*

[10] Bulk Oil Storage and Transport company

Foreword

THE ENERGY COMMISSION has the mandate to prepare, review and update periodically indicative national plans to ensure that all reasonable demands for energy are met in a sustainable manner. In addition, the Energy Commission is mandated to secure and maintain a comprehensive data base for national decision making for the efficient development and utilisation of energy resources available to the nation. Energy Commission's jurisdiction include promoting and ensuring uniform rules of practice for the production, transmission, wholesale supply, distribution and sale of electricity and natural gas.

In fulfilment of its mandates, the Energy Commission in 2006, published the Strategic National Energy Plan for Ghana (SNEP) covering the period 2006-2020. The Commission has been preparing annual energy demand and supply forecasts to provide some guide to the energy sector operators and potential investors as well as the wider business community wishing to operate in the country. The purpose of the 2013 Annual Energy Outlook therefore is intended to give government, industry and business, indications of the levels/quantities of electricity, liquid and gaseous fuels that would be required to be provided by the energy producers.

This document covers demand and supply of electricity, crude oil and petroleum products, natural gas as well as charcoal. Even though, no forecast for electricity prices is included, higher thermal generation mix and increasing fuel price would lead to higher generation cost. The rate of cost increase would be lower if more natural gas which is less expensive than oil is made available to replace oil in the generation mix. High cost of crude oil would also lead to higher petroleum product prices. Inadequate supply of LPG leads to higher charcoal consumption and consequently more wood for charcoal production. Average price of charcoal is also increasing.

In the document, 'Demand' is used when referring to gross fuel or energy required by a demand sector, e.g. Residential, Commercial, or Industry. 'Supply Requirement' is Supply or Generation/Production + transmission/transport losses. For further elaboration, please refer to Annex 1 of the document for a schematic overview of Ghana's Energy Demand and Supply System.

This report was prepared by the Strategic Planning and Policy Division of the Energy Commission. General questions about the report should be referred to Mr. Michael Opam, (mopam@energycom.gov.gh, michaelopam@yahoo.com) Director, Planning and Policy Directorate. Specific questions about the content may be directed to Dr. Joseph Essandoh-Yeddu (essandohyj@energycom.gov.gh, jeyeddu@hotmail.com), Head of Strategic Planning and Policy Division.

Your comments are most welcome.

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1.0 Power Subsector

1.1 Overview of grid power supply in 2012

Installed generation capacity available for grid supply as at the end of 2012 was 2,296 Megawatt (MW) (*see Table 1*).

Table 1. Installed Electricity Generation Capacity as of December 2012.

GENERATION PLANT	FUEL TYPE	INSTALLED CAPACITY
		MW
Hydro Power Plants		
Akosombo	Hydro	1,020
Kpong	Hydro	160
Sub-Total		*1,180*
Thermal Power Plants[11]		
Takoradi Power Company (TAPCO)	LCO/NG/diesel	330
Takoradi International Company (TICO)	LCO/NG/diesel	220
Sunon–Asogli Power (SAPP)	NG	200
Tema Thermal Plant1 (TT1P)	LCO/NG/diesel	110
Mines Reserve Plant (MRP)	Diesel/NG	80
Tema Thermal Plant2 (TT2P)	NG	50
CENIT Energy Ltd (CEL)	LCO/NG	126
Sub – Total		*1115.5*
Total		**2,296**

NG is Natural gas

The total electricity made available for gross transmission in 2012 was 12,164 GWh as against 11,200 GWh in 2011. The 2012 generation comprised 8,071 GWh (67%) hydropower and 3,639 GWh (33%) of thermal power. Even though, hydropower generation share decreased by about 0.5 percentage points over 2011, energy produced increased by about 510 GWh due to significant water inflows into the Akosombo reservoir in 2012[12].

The Ghana load at peak on the transmission grid was 1,729 MW and the grid system (maximum) peak was 1,871 MW.

Total power transmission losses in 2012 was 4.3% of gross transmission, 0.4 percentage point improvement over 2011 (*see Table 2*).

[11] TAPCO is Takoradi Power Company, a combined cycle (CC) thermal plant; TICO is Takoradi International Power Company, a single cycle (SC) thermal plant

[12] GRIDCo submissions to the Energy Commission, March, 2013

Table 2. Transmission losses since 2008.

Year	2008	2009	2010	2011	2012
Transmission losses as % of gross transmission	3.7	3.8	3.7	4.7	4.3

1.2 2012 forecasts and actuals

For 2012, we projected that the total electricity required would be between 12,394-14,673 GWh**,** and that 11,000-12,000 GWh would come from the existing grid. We also projected that oil required for thermal power generation would range from a minimum of 600,000 tonnes to a maximum of 700,000 tonnes (about 3-5 million barrels) during the year, depending upon the availability of the thermal plants and the volatility of the oil price.

Total WAGP gas flow in 2012 was 15,491,670 MMBtu (15,492 mmscf) which was about half the 2011 supply; 30,524,557.83 MMBtu (30,525 mmscf). Average WAGP gas flow per day for the period of flow was also lower; 65 mmscfd compared to about 95 mmscfd in 2011. (*see Tables 3 and 4*).

Table 3 Average Natural Gas Supply from WAGP in 2012.

Month	MMBtu per day	mmscfd
January	73,657	74
February	42,589	43
March	61,321	61
April	57,225	57
May	56,914	57
June	48,917	49
July	82,176	82
August	91,684	83
Mean	***64,537***	***65***
Assumed 1000 MMBtu = 1mmscf		

WAGP gas supply was interrupted at the end of August, 2012 following a rapture of the pipeline in Togolese waters that month. Since then, gas has not flowed to Ghana at the time of producing this document[13].

Table 4. Grid Electricity and associated fuels: Forecasts and Actuals for 2012.

	2011	2012	
		Forecast	**Actual**
Total Electricity Requirement (GWh)		12,394-14,673	
Grid Electricity (GWh)	11,200	11,000-12,000	12,164
Percentage hydro (%)	67.5	66-68	67
System Peak/Maximum Demand* (MW)[*])	1,520-1,665	1,700-1,800	1,729-1871
Mean WAGP gas flow range **(**mmscf per day)	94-96	65-75	65
Oil required/consumed 1000 Tonnes (Million barrels)	~ 260 (~ 2)	400-700 (3-5)	704 (~5)
WAGP Gas transportation tariff ** US$ per mscf *($ per MMBtu)*	4.04-4.17 *(3.963-4.065)*	4.15-4.27 *(4.08-4.19)*	4.25 *(4.175)*
Average price for WAGP Gas*** US$ per mscf *($ per MMBtu)*	2.499 *(2.454)*	2.57-2.60 *(2.53-2.55)*	2.63 *(2.587)*
Total delivered gas price ** *(other charges included)* US$ per mscf *($ per MMBtu)*	6.68-8.14 *(6.56-7.99)*	8.15-8.9.16 *(8-9)*	8.34 *(8.188)*
Average price for light crude oil ***purchased for power production*** US$ per bbl *($ per MMBtu gas equiv.)*	111 (*18.90*)	120-125 (20.*62-21.48*)	~ 115 *(19.72)*
Average price for Brent crude US$ per bbl *($ per MMBtu gas equiv.)*	111	120-130	~ 113 *(Global ~112)*

**Actuals data obtained from GridCo. Low-side is Ghana/local and high-side is total system peak*
*** Actual data in $/MMBtu courtesy of WAPCo. Low-side for Foundation customers and high-side for Standard customers. Other charges include delivery fee, ELPS transport fees, insurance, etc.*
**** Prices indexed to LCO and negotiated between the buyer and supplier and reviewed every six months. Actual data in $/MMBtu courtesy of WAPCo. Low-side for Foundation customers and high-side for Standard customers.*

[13] Enquiries from WAPCo, January 2013.

Global Brent crude price averaged $112 per barrel in 2012. Average price however at which Ghana purchased the crude hovered around $113 per barrel but fell between $95-102 per barrel during the summer. In cognisance with the oil price uncertainties during the year, the Volta River Authority (VRA), the nation's largest power producer hedged 500,000 barrels of its crude oil purchases *(about one-tenth of its expected procurement for the year*) at a price slightly below $115 per barrel[14].

1.3 Forecast for 2013

Ghana's real Gross Domestic Product (GDP) growth in 2012 was estimated to drop to between 7.9-8.5% from a high of 14.4% in 2011[15]. The dip in the GDP growth was attributed to slow growth in manufacturing and the utilities subsectors in 2012. Economic experts project further decrease but modestly high GDP growth of 7.1% for 2013 still largely on account of improved Jubilee field commercial oil production expected in 2013[16].

At such high GDP growth rate, we projected under SNEP (2006-2020)[17] that the total electricity generation[18] required for the country in 2013 would be as follows:

- **19,500-20,210 GWh** with VALCO operating at not more than two potlines; and
- **20,210-24,770 GWh** for VALCO to be operating at 4-5 potlines.

The corresponding maximum peak (including suppressed demand) would have been between **1,987-2,556 MW** which translates into about **2,500-3,100 MW**[19] dependable capacity required.

However, this is not attainable considering the limited installed grid power generation capacity in the country and also lack of significant potential electricity import (*see Table 5*). The technically dependable capacity and the optimum grid power generation available in 2013 is estimated at **2,267 MW** and **16,121 GWh** respectively (*see Table 5*). The corresponding maximum peak (including suppressed demand) would be between **1,800-2,000 MW.** The relatively wide range is due to the high uncertainties in the availability of adequate gas supply.

[14] CAPE3 monthly newsletter on oil and gas in Ghana, June, 2012. www.cape3org.com Bank of Ghana, Statistical Buletin, December 2012.
[15] Ghana Statistical Service (GSS) projected 7.1% whilst other economic think-tanks including CEPA (Centre for Economic and Policy Analysis) and Ernest & Young projected 8.5%
[16]Ernst & Young, 2012Report on Ghana's economic growth, July11, 2012; Business Monitor International, Ghana: Business Forecast Report, 4th Quarter 2012.
[17] Strategic National Energy Plan (2006-2020), Energy Commission, available at www.energycom.gov.gh
[18] Total electricity generation=grid/public generation + private back-up generation
[19] Low-side value if VALCO is shut down; high-side if VALCO is fully in operation.

Table 5. Grid Power Generation Capacity available for 2013.

GENERATION PLANT	CAPACITY (MW)		Plant Availability Factor	Expected Energy (GWh)
	Installed	Dependable		
Hydro Power Plants				
Akosombo	1,020	960	0.90	7,568.64
Kpong	160	140	0.90	1,103.76
Bui	130	100	0.90	788.4
Sub-Total	*1,310*	*1,200*		*9,460.80*
Thermal Power Plants[20]				
TAPCO (CC)	330	300	0.70	1,839.6
TICO (SC)	220	200	0.80	1,401.6
Sunon – Asogli (gas)	200	180	0.68	1,072.224
Tema Thermal Plant – TT1PP	110	100	0.85	744.6
Tema Thermal Plant – TT2PP	50	45	0.85	335.07
Takoradi 3 (T3)	132	120	0.50	525.6
Mines Reserve Plant (MRP)	0	35	0.75	229.95
CENIT Energy Ltd	126	120	0.70	735.84
Sub-Total	*1,168*	*1,065*		*6,654.53*
Solar Power Plants				
VRA Solar grid-inter-tied	2	2	0.3	5.26
Sub – Total	*2*	*2*		*5.26*
Total	**2,480**	**2,267**		**≈16,121**

Fuel supply challenge and likely impact on generation

The required supply of natural gas expected from Nigeria through WAGP gas supply this year, 2013 would worsen due to its interruption at the end of August, 2012 following pirate activities in the Togolese waters that month. Average supply before the interruption in August, 2012 was about 65 mmscfd. The pipeline has since been repaired but Ghana is not likely to see any flows greater than daily average of **40 mmscfd** in 2013. Eventual supplies to the country for the rest of the year would be very erratic. Political and economic developments in Nigeria are also fuelling a conspiracy theory that gas may hardly flow in 2013, since there seems to be no logic for the said country to let go gas to neighbouring

[20] TAPCO is Takoradi Power Company, a combined cycle (CC) thermal plant; TICO is Takoradi International Power Company, a single cycle (SC) thermal plant

countries when there are thermal power plants in that country built but inoperative due to lack of gas supply to the plants. The Nigerian Commercial Group has so far reneged on their promise to the extent that supplies since 2011 are yet to reach their contract volumes.

The Sunon-Asogli-plant which is wholly natural gas fuelled has been out of operation since August 2012 to date.

This has the potential to reduce the projected dependable capacity and available generation further to about **2,167 MW** and **13,459 GWh**, unless more efforts are made to augment the loss in the required gas supply with adequate oil supply (*see Table 6*).

Table 6. Grid Power Generation Capacity available for 2013 with less gas supply

GENERATION PLANT	CAPACITY (MW)		Plant Availability Factor	Expected Energy (GWh)
	Installed	Dependable		
Hydro Power Plants				
Akosombo	1,020	960	0.94	7568.64
Kpong	160	140	0.90	1103.76
Bui	130	100	0.90	788.4
Sub-Total	*1,310*	*1,200*		*9,460.80*
Thermal Power Plants[21]				
TAPCO (CC)	330	300	0.50	1314.2
TICO (SC)	220	100	0.68	595.68
Sunon – Asogli (gas)	200	180	0.30	473.04
Tema Thermal Plant – TT1PP	110	100	0.50	438
Tema Thermal Plant – TT2PP	50	45	0.30	118.26
Takoradi 3 (T3)	132	120	0.50	525.6
CENIT Energy Ltd	126	120	0.50	525.6
Sub-Total	*1,168*	*1,065*		*3,990.38*
Solar Power Plants				
VRA Solar grid-inter-tied	2	2	0.3	5.26
Sub – Total	*2*	*2*		*5.26*
Total	**2,480**	**2,167**		**≈13,459**

[21] TAPCO is Takoradi Power Company, a combined cycle (CC) thermal plant; TICO is Takoradi International Power Company, a single cycle (SC) thermal plant

We however expect Ghana's own gas from the Jubilee field operations to be available during the last quarter of 2013.

With these developments, we estimate that the likely average annual gas supply for 2013 would be between **45-50 mmscfd** (about **45,000-50,000 MMBtu per day**).

We however do not expect the total delivered gas price to fall outside **$8-9 per MMBtu**. We expect the average global Brent crude oil price to decline slightly in 2013, falling to **$108-110 per barrel**, from $111 per barrel in 2012. The total quantity of oil required in 2013 to fire the thermal plants would however **be about double** that of 2012 (*see Table 10*).

On other hand, we expect the trend of average annual precipitations for 2013 to be higher than 2012 as this year coincides with the maximum sunspot cycle (solar maximum) of the sun which is usually associated with higher convection currents and consequently higher rainfalls. Indications from the Ghana Meteorological Agency[22] also corroborate this fact and that the mean annual rainfall is expected to be higher this year than in 2012. Higher inflows into the hydropower reservoir would improve the overall power generation in the light of lower than expected gas supply this year.

1.4 The potential drivers for electricity consumption

Under contemporary circumstances, we project that the potential drivers for electricity consumption would be the same as in 2012 and are as follow:

- Aluminium production should VALCO continue and expand operation;
- Industry besides VALCO, largely mining and influenced by gold production;
- Other or general Industrial share also growing;
- On-going national electrification scheme;
- Natural or organic economic expansion; and
- Petroleum up-stream and mid-stream activities.

Aluminium production

The Volta Aluminium Company, VALCO is the country's single largest non-utility customer when in full operation. The smelter has an installed capacity of 200,000 tonnes of primary aluminium production at a maximum power demand of 320 Megawatt with five potlines,

[22] 2013 Meteo forecast, Ghana Meteorological Agency

consuming about 2,900 GWh per year. The fifth potline however, has not been fully available and hence the plant had operated a maximum of four and a half potlines with maximum production of 180,000 tonnes per annum.

Primary aluminium production in general is energy-intensive. Electricity intensity of production at VALCO averaged 17 Megawatt-hour per tonne of aluminium in the early 1990s but has improved to the present average of 16.2 Megawatt-hour per tonne. Aluminium smelting worldwide is very sensitive to electricity pricing and both are highly correlated. At larger production volumes, high electricity tariffs become cost competitive.

Aluminium has become the world's second most used metal after iron and is today the single most important non-ferrous metal. Global demand was about 39 million tonnes in 2010 and this is projected to exceed 100 million tonnes by 2020 with an estimated annual growth rate ranging between 6.5-10%[23] Global aluminium production in 2011 was almost 44 million tonnes and demand was projected to reach 49 million tonnes by end of 2012, i.e. last year, driven largely by surging demand in Asia.

Average world market price of the metal dropped from the range of $2,600-$2,800 per tonne in 2011 to $2,060-2,127 per tonne in 2012.

The global average price is expected to weaken further this year, i.e. 2013 as a result of continuous drop in demand in Europe caused by the prevailing economic depression in the region. Experts project a drop to less than $2,000 per tonne (i.e. $1,800-2,000 per tonne) from the high range in 2011. Even at this price range and for production of 120,000-160,000 tonnes of aluminium per annum, i.e. operating three-to-four potlines, VALCO would be in business at a tariff of 4.5-6.5 cents per kWh[24]. The downside is that there has not been enough electricity generation capacity to support VALCO's operations at that production level since 2000.

Whenever there had been nationwide supply shortage, VALCO had been forced to curtail operations. In 2003-2004, the nation experienced nationwide load shedding and VALCO which then accounted for 26-40% of the total electricity consumption and about 50% of electricity consumed by industry, was called upon to either shut down or reduce production significantly. Consequently, VALCO had been almost out of the electricity consumption share since 2004 except in 2006 when it was made to come on line. Since then it had not operated beyond two potlines as a result of inadequate power.

For VALCO to operate between two-three potlines, we estimate electricity requirement of **600 GWh** for one more potline and **1,200-1,300 GWh** for two more potlines in 2013.

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[23] International Aluminium Institute, https://stats.world-aluminium.org/iai/stats; Alcoa group, www.alcoa.com/ extracted in March, 2011.

[24] Aluminium smelter economics is as such that the high the production levels, the easier to operate on higher tariffs. Refer to SNEP 2006-2020, Annex I of IV, Energy Commission, www.energycom.gov.gh/documents

Gold production

Gold surpassed cocoa as the country's number one foreign exchange earner in the 1990s, and had accounted for 43-47% of merchandised export earnings since 2006[25]. Gold which was around $400 per ounce in 2004 rose to an average of $1,572 per ounce in 2011 and hitting a record average of $1,668 in 2012 as the precious metal provides safe haven as well as alternative to the United States dollar (*which is said to be losing in value*) for investors who are worried by the general global economic uncertainty particularly of the United States and also of the Eurozone [26].

Ghana's annual gold production increased from 77 tonnes in 2007 to 79.5 tonnes in 2008. We predicted that it could exceed 80 tonnes in 2010 due to favourable global price and it did, in fact reaching over 84 tonnes (2.97 million ounces) in 2010[27].

Production has climbed to a record 119 tonnes (almost 4.2 million ounces) in 2012, from about 89 tonnes (almost 3.14 million fine ounces) in 2011 which is unprecedented in modern Ghana's gold mining history. Total revenue in 2011 from the commodity was about $5 billion about 30% more over 2010 earnings[28].

Gold production is expected to continue to soar and could hit 127 tonnes (4.5 million ounces) by the end of 2013 due to upward surge in prices. Also, new mining operations are expected to add between 300,000-500,000[29] ounces in 2013.

Despite the projected surge in production, the global average price is expected to fall below the 2012's average price of $1,668 this year, i.e. 2013 as a result of expected improvement in the U.S economy but also some European economies off-loading some of their gold reserves unto the world market.

Gold is a rare but precious metal. Global gold output has averaged between 2,500–3,000 tonnes every year since the beginning of the decade. Ghana, ranks as the world's 10^{th} – 12^{th} producer and the second highest on the continent after South Africa.

Four main factors influence gold production technology, particularly, as whether to opt for surface or underground mining. They are the (i) richness or concentration of the ore; (ii) production costs, (iii) world market price of gold and (iv) energy price. For most surface mines in Ghana, the concentration of gold is between 2–3 grammes per tonne of ore, reducing to 1–2 grammes per tonne for workable tailings. For underground mining, concentration could go as high as 8–12 grammes per tonne of ore on the average in Obuasi underground but drops to a range of 3–5 grammes per tonne of ore for other areas of the

[25] Bank of Ghana Statistical Bulletin, December, 2012.
[26] Bloomberg L.P., 2013.
[27] 2010 Energy Outlook, Energy Commission.
[28] Bank of Ghana Statistical bulletin October 2012; http://goldprice.org
[29] Newmont's second gold mine at Akyem is expected to start commercial production in 2013 with as much as 450,000 ounces annually. BullionStreet, 2013

country. In general for any given mining area, the ore is richer as one goes deeper underground.

Electricity consumption for underground operations is about three times that for surface mining operations. Electricity intensity of surface gold mining in the country is 8-9 GWh per tonne of gold whilst underground mining requires between 28-29 GWh per tonne of gold [30].

Electricity supply for surface mining is mainly for pumping and grinding of the ore. For underground mining, besides pumping and grinding, electricity is required for operating the transport-elevators, drilling, air-conditioning and ventilation.

The general observation is that the ambient temperature increases by 10 degrees Celsius for every kilometre below the surface of the earth.

Most operations thus shift from underground to surface mining, when cost of electricity per production of ounce of gold exceeds about 10 percent of the prevailing world market price of gold. The benchmark is for energy cost per production not to exceed 20%. Surface mining is a less expensive technology but has more serious environmental consequences for surrounding communities and the nation as a whole.

Fortunately, at the prevailing global market price of gold, exceeding $1,400 per ounce, the 20% energy cost benchmark is not exceeded even for diesel oil prices averaging $140 per barrel and electricity tariff below 20 US cents per kWh. We thus project deep or underground mining operations to increase or potentially double this year, particularly at Obuasi, Tarkwa and Prestea mines, the latter which had been moribund for the past years.

For the additional or marginal production of about (300,000-450,000 ounces) 8-10 tonnes new gold expected in 2013, we forecast a range **232-450 GWh** where the low-side represent half production from surface mining and half of production from deep or underground mining whilst the high-side representing half production from surface mining about full production from deep or underground mining.

Other Industries[31]

The share of electricity supplied to the industrial sector (VALCO inclusive) has shown wide variability since 2000 and indeed it was the sector most severely affected during the load shedding in 2003-2004 and 2007 (*see Table 7*)[32].

The shares of electricity supplied to the industrial (VALCO inclusive) and the Non-residential comprising Commercial & Service sectors for the past three years had shown increasing trends whilst share of supply to the Residential Sector had seemingly decreased.

[30] SNEP 2006-2020, Volume 1, Energy Commission, 2006. page 34. (point 160)
[31] Industry other than VALCO and Gold Mining.
[32] The country underwent a nationwide load shedding from 2002-2004 due to low inflows into the Volta reservoir which culminated into reduced generation (about one-third to half capacity less) from the nation's hydropower.

Table 7 shows final electricity reaching the demand sectors.

Table 7. Grid Electricity supply, share and growth to the Demand Sectors since 2000.

YEAR	DEMAND SECTORS										
	Industry			Non Residential			Residential			Total	
	1000 GWh	% Share	% Gr	1000 GWh	% share	% Gr	1000 GWh	% share	% Gr	1000 GWh	% Gr
2000	4.31	68.0	*0*	0.55	8.7	0	1.49	23.5	*0*	**6.34**	***0***
2001	4.33	66.4	*0.5*	0.58	8.7	*5.5*	1.61	24.7	*8.1*	**6.53**	***3.0***
2002	3.90	63.2	*-9.9*	0.60	9.8	*3.4*	1.67	27.1	*3.7*	**6.17**	***-5.5***
2003	2.21	48.6	*-43.3*	0.62	13.6	*3.3*	1,73	38.0	*3.6*	**4.55**	***-26.3***
2004	2.03	448	*-8.1*	0.66	14.6	*6.5*	1.78	39.3	*2.9*	**4.53**	***-0.4***
2005	2.54	49.2	*25.1*	0.70	13.6	*6.1*	1.92	37.2	*7.5*	**5.16**	***13.9***
2006	3.59	55.1	*41.3*	0.79	12.1	*12.9*	2.13	32.7	*10.9*	**6.51**	***26.2***
2007	2.70	48.3	*-25.0*	0. 80	14.3	*1.3*	2.10	37.6	*-1.4*	**5.59**	***-14.1***
2008	2.97	48.2	*10.0*	0.93	15.1	*16.3*	2.27	36.9	*8.1*	**6.16**	***10.2***
2009	2.94	47.2	*-1.0*	0.88	14.1	*-5.4*	2.41	38.7	*6.2*	**6,23**	***1.1***
2010	3.16	46.1	*7.5*	0.97	14.1	*10.2*	2.74	39.9	*13.7*	**6.86**	***10.1***
2011	3.90	48.9	*23.4*	1.31	16.4	*36.1*	2.76	34.6	*0.7*	**7.98**	***16.3***
2012	4.20	51.9	*7.7*	1.30	16.0	*-0.8*	2.60	32.1	*-5.8*	**8.10**	***1.5***
Mean Growth[33]			***2.2***			***7.3***			***4.5***		***2.8***
Note: Gr is growth rate											

As VALCO's power consumption share continued to drop over the years, the Mining subsector of Industry *which is dominated by gold mining* and the Other industries[34] have taken over with the latter maintaining the largest share (*see Table 8*).

Table 8. Industrial Sector Grid Electricity supply and shares since 2000.

YEAR	INDUSTRY SECTOR								
	VALCO			MINES			OTHER INDUSTRIES *(i.e. less VALCO less MINES)*		
	1000 GWh	% Share of Industry	% Share of Total Electricity	1000 GWh	% Share of Industry	% Share of Total Electricity	1000 GWh	% Share of Industry	% Share of Total Electricity
2000	2.50	58.0	*39.4*	0.63	14.6	*9.9*	1.17	27.1	*18.5*
2001	2.56	59.1	*39.2*	0.57	13.2	*8.7*	1.20	27.7	*18.4*
2002	2.06	52.8	*33.4*	0.56	14.4	*9.1*	1.28	32.8	*20.7*
2003	0.25	11.3	*5.5*	0.57	25.8	*12.5*	1.38	62.4	*30.3*
2004	0.01	0.5	*0.2*	0.60	29.6	*13.2*	1.42	70.0	*31.3*
2005	0.26	10.2	*5.0*	0.75	29.5	*14.5*	1.53	60.2	*29.7*
2006	1.20	33.4	*18.4*	0.87	24.2	*13.4*	1.52	42.3	*23.3*
2007	0.21	7.8	*3.8*	1.00	37.0	*17.9*	1.48	54.8	*26.5*
2008	0.17	5.7	*2.8*	1.14	38.4	*18.5*	1.65	55.6	*26.8*
2009	0.01	0.8	*0.2*	1.25	42.5	*20.1*	1.66	56.5	*26.6*
2010	0.01	0.3	*0.1*	1.24	39.2	*18.1*	1.91	60.4	*27.8*
2011	0.60	15.4	*7.5*	1.30	33.3	*16.3*	2.00	51.3	*25.1*
2012	0.60	14.3	*7.4*	1.40	33.3	*17.3*	2.20	52.4	*27.2*

[33] Average growth based on geometric mean which is more appropriate than the arithmetic mean for describing proportional growth

[34] i.e. excluding the mines, besides VALCO.

We estimate a net electricity requirement of **320-350 GWh** for 2013 based on the 2000-2012 growth and that of 2011-2012 growth of the Other Industries.

National Electrification Scheme

The Ministry of Energy in 1989 instituted the National Electrification Scheme (NES) as Government's principal policy to extend electricity to all parts of the country over a 30-year period from 1990-2020.

643 communities were connected to the national grid in 2012, bringing to the total of communities connected nationally to about 5,500 and a national average coverage of about 72% as of December 2012, just as in 2011 due to population growth catching up with the rate of electrification[35]. All regional and district capitals have been connected to the national grid. According to the Ministry of Energy, over 3,000 communities earmarked for electrification since 2011 would continue. Also, funding arrangement had been secured for about 2,000 communities earmarked for electrification in 2013 and beyond.

However, as it had been since 2011, it is not likely that all earmarked communities would be connected to the grid in 2013. We have therefore maintained the national average residential electricity consumption rate from 2000-2010 as the minimum growth rate and the consumption growth rate between 2009-2011 as maximum as used in the *2012 Energy Outlook*, we thus estimate a net electricity requirement of **172-375 GWh** for 2013, as a result of the National Electrification Scheme.

Natural or organic economic growth

Allowing for natural demand growth due the expansion of the economy, using national electricity growth from 2000-2012 as maximum and growth between 2011-2012 as minimum, we estimate additional **122-978 GWh** to be required.

Petroleum Up-stream and Mid-stream activities

The petroleum upstream covers offshore FPSO[36] vessel operations which involves the production of oil and gas from the Jubilee field. The midstream operations cover the gas evacuation through an undersea pipeline to the processing plant which would receive the associated natural gas from the Jubilee field in the Tano (Western) Basin and process it into lean gas, LPG and other condensates.

The oil production upstream requires between 15-40MW a day for its operations. This is expected to increase to 50-60MW when oil production reaches 120,000 barrels a day. Electricity consumption on the drilling ship is between 300-400 GWh per annum but the fuel supply is natural gas directly from the oil operations offshore. Construction of the gas processing plant is expected to ramp up in early 2013 to ensure completion by end of third

[35] Ministry of Energy, Power Sector, National Electrification Scheme, 2011, www.energymin.gov.gh
[36] Floating, Production, Storage and Off-loading vessel.

quarter of the year. This would require between **100-200 GWh** annually for its major welding and utility operations until completion.

Energy Efficiency and Conservation measures

In order to ameliorate the challenging electricity demand and supply imbalance facing the country, the Energy Commission has already put in place conservation measures and programmes that have resulted in significant reduction of the electricity system load over the years.

In 2009, automatic capacitor banks were installed in six public institutions, leading to a total estimated savings of 1,851kVA by this intervention. The second phase involving 26 selected public institutions across the country could not be implementation in 2012 for technical reasons but would be implemented and completed in 2013 with expected savings estimated at 1875kVA or about **15 GWh**.

In the last quarter of 2011, the Energy Commission commenced the Refrigerator Energy Efficiency project which would run up to 2014. The project intends to introduce very efficient refrigerators into the economy with the potential of reducing electricity consumption in refrigerators by 50% in the medium term. It is targeting over two million inefficient refrigerators in use in the country each consuming on the average 1,200kWh per year as against 250kWh per year for very efficient ones. In the short term, the project is targeting about 15,000 refrigerators by mid 2014 with estimated savings of about **8 GWh**.

Table 9 presents the summary of the additional electricity requirement to top up the 2012 production in order the meet that of 2013.

Table 9. Summary of estimates for additional electricity requirement for 2013.

Demand Drivers	**Minimum**	**Maximum**
VALCO	*One more Potline* 600 GWh	*Two more Potlines* 1,200 – 1300 GWh
Gold mining	*Surface mining* 200-232 GWh	*Deep mining* 400-450 GWh
Other Industries	320	350
National Electrification	172 GWh	375 GWh
Natural GDP growth	*National Average 2000-2012 electricity growth* 121 GWh	*2010-2012 electricity growth* 978 GWh
Gas processing construction	100 GWh	200 GWh
Demand-side management	-10	-23
Total	**1,503-1,535**	**3,480-3,630**

Summary of forecast for the power sector for 2013 is as follows (see *Table 10*):

Table 10. Summary of Power Sector forecast for 2013

Total electricity requirement *(VALCO at 3-4 potlines in brackets)* GWh	13,667-15,794 *(16,100-19,500)*
Likely grid electricity supply GWh	13,459-16,121
Percentage Hydropower %	58-68[37]
Shortfall in capacity for reserve margin MW	350-450
System Peak/Maximum Demand *(VALCO at 3-4 potlines in brackets)* MW	1,800-1,900 *(1,987-2,500)*
Expected Mean Annual WAGP gas flow rate MMBtu per day *(mmscf per day)*	45,000-50,000 *(45-50)*
WAGP Gas transportation tariff ** $ per MMBtu *($ per mscf)*	4.17-4.30 *(4.19-4.32)*
Average price for WAGP Gas (cif) ** $ per MMBtu *($ per mscf)*	2.58-2.59 *(2.60-2.62)*
Total delivery price of gas $ per MMBtu *($ per mscf)*	8.50-9.00 *(8.66-9.17)*
Optimum crude oil (LCO) requirement Million barrels *(kilotonnes)*	8-9 *(1,158-1,250)*
Average price for light crude oil *dedicated for power production* $ per bbl *($ per MMBtu)*	100-102 *(~17-18)*
Average price for Brent crude $ per bbl *($ per MMBtu)*	108-110 *(~18-19)*
***Low-side is for foundation customers and high-side for standard customers.*	

[37] Depending upon availability of less expensive fuel which is natural gas.

2.0 Petroleum Subsector: Oil

2.1 Overview of petroleum supply in 2012

Saltpond field

Total oil production from the Saltpond field in 2012 was about 105,000 barrels with daily and monthly productions averaging about 290 and 8,800 barrels respectively. The trend from the previous years might be an indication that either the field has matured or drying up" (*see Figure 1*).

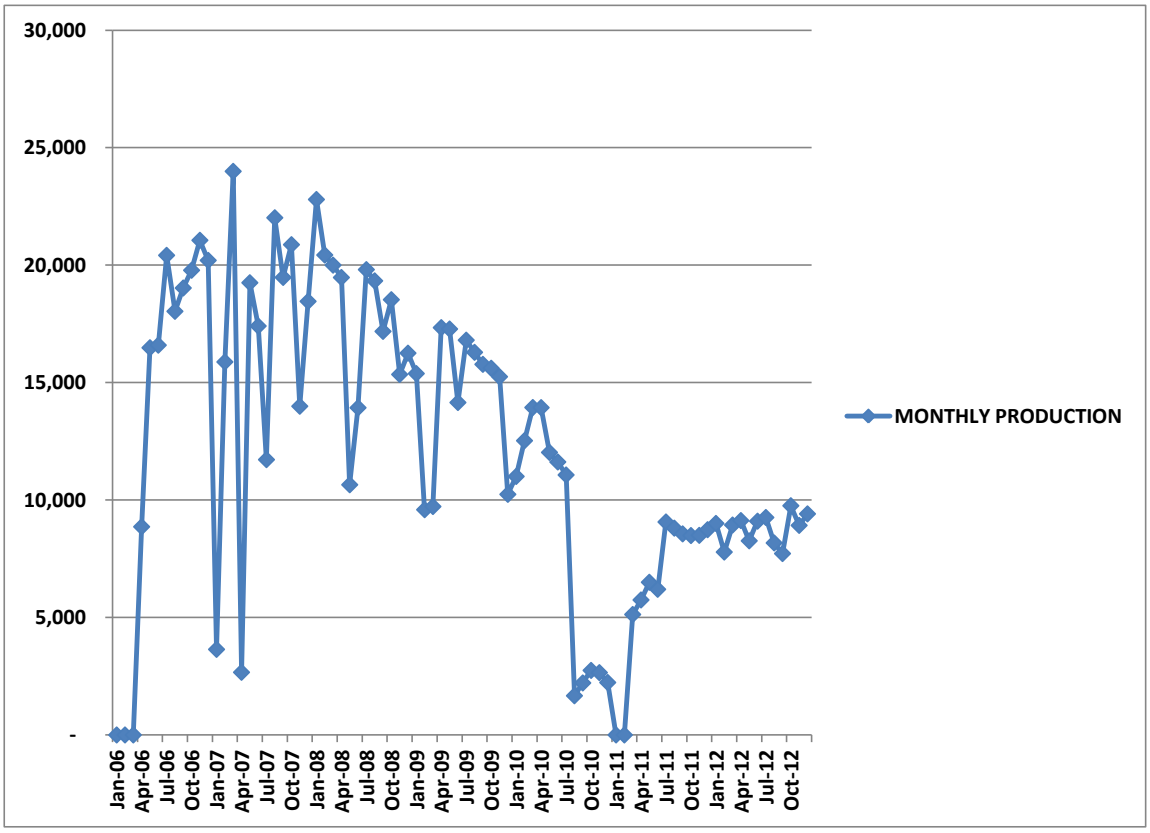

Figure 1. Trend of Saltpond field oil production since 2006

Jubilee field

Total oil production from the Jubilee field in 2012 on the other hand was 27.4 million barrels compared with 23.8 million barrels in 2011, an increase of 15% over the previous year.

Average daily oil production from the Jubilee field increased to about 81,000 barrels in 2012 from about 73,000 barrels in 2011, though, unable to reach the target of 120,000 barrels per day as projected by the industry for 2012. The last month of 2012 however crossed 100,000 barrels a day production, thanks to the corrective measures effected by Tullow Oil plc, the operator of the field (*see Figure 2*) [38].

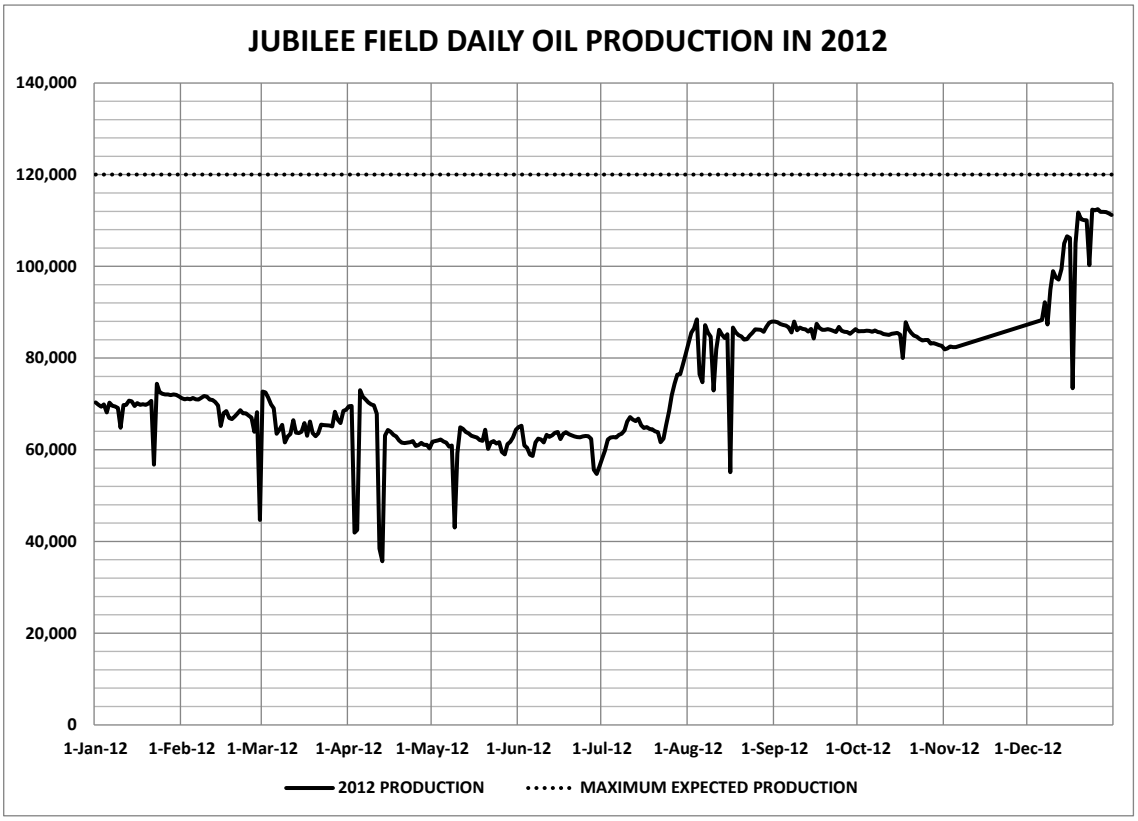

Figure 2. Jubilee field daily oil production in 2012

Crude oil from the Jubilee fields was sold at an average price of about $113 per barrel[39].

Domestic consumption and stocks in 2012

Crude oil imported for domestic consumption was about 1.2 million tonnes in 2012 compared to about 1.5 million tonnes in 2011; a drop of about 21% from the previous year's

[38] Jubilee field operations update: Tullow, January 2012.
[39] Sourced from Bank of Ghana and Ministry of Finance, December 2012; first quarter - $119; second quarter- $112; third quarter-108; fourth quarter- estimated at $111.7.

and also a drop of about 27% from 2010. Electricity production accounted for 58.2% of the crude oil consumption whilst primary refinery operations accounted for the remaining 41.8%.

Monthly average prices of crude oil sourced by Ghana in 2012 was within $124-126 per barrel between February and April but dropped to below $110 per barrel between May and July of the year; it was about $96 per barrel in June.

Table 11 compares the Ghanaian sourced oil prices and those of West Texas Intermediate (WTI) representing the United States and the London Brent representing Europe.

Table 11. Average crude oil prices in Ghana, United States (Gulf Coast), and Europe (the North Sea).

Year	Ghana	WTI Gulf Coast/ United States	Brent Crude North Sea/ United Kingdom
	U.S dollars per barrel		
2010	80	79.4	70
2011	111	94.9	111
2012	113	93.3	112

Source: Bank of Ghana, LondonGasPrice.com, tradingnrg.com

Total products consumed in 2012 amounted to about 3.2 million tonnes, about 14% over 2011 (*see Table 12*). [40]

Table 12. Petroleum product consumption for 2012

PETROLEUM PRODUCT	2010	2011	2012	*CHANGE*	
				b/n 2010 & 2011	*b/n 2011 & 2012*
	1000 tonnes			*Percentage*	
LPG	178.4	214.4	268.5	*20.2*	*25.2*
Gasoline	737.8	807	992.7	*9.4*	*23.0*
Premix	32.4	45.5	58.9	*40.4*	*29.5*
Kerosene	49.3	62.4	45.6	*26.6*	*-26.9*
ATK	108.4	135.3	141.3	*24.8*	*4.4*
Gas oil/diesel	1,271.90	1,511.5	1,665	*18.8*	*10.2*
RFO	30.9	37.5	33.5	*21.4*	*-10.7*
Total	**2,409.10**	**2,813.70**	**3,205.50**	***16.8***	***13.9***

Source: National Petroleum Authority, 2012.

[40] Stocks from the previous year but held by the oil marketing companies might have added up to the supply in the year to make up the total consumption.

The three highest movers in 2012 were premix gasoline, LPG and gasoline; whilst 2011 had premix gasoline, kerosene and ATK as the highest movers.

Petroleum products imported in 2012 were about 2.5 million tonnes, an increase of about 17.5% over imports in 2011. Growth in gasoline and diesel oil imports dropped from 25% and 38% respectively in 2011 to about 14% and 9% respectively in 2012. The highest imported product dual purpose kerosene (DPK) which went up from 17,500 tonnes in 2011 to about 115,000 tonnes in 2012 most probably due to the growth of the domestic aviation industry.

Total oil products supplied (comprising local production and imports) to the economy continued to show an upward trend; it was about 2.4 million tonnes in 2012 compared to 2.3 million in 2011 but continued to lag behind consumption (see Figure 3). Products exported were largely marine gas oil (MGO) sold to foreign vessels, aviation fuel sold to international airlines and heavy gasoline and designer-gasoline formulations. Total product exports dropped from 746,400 tonnes in 2011 to 533,900 tonnes in 2012[41].

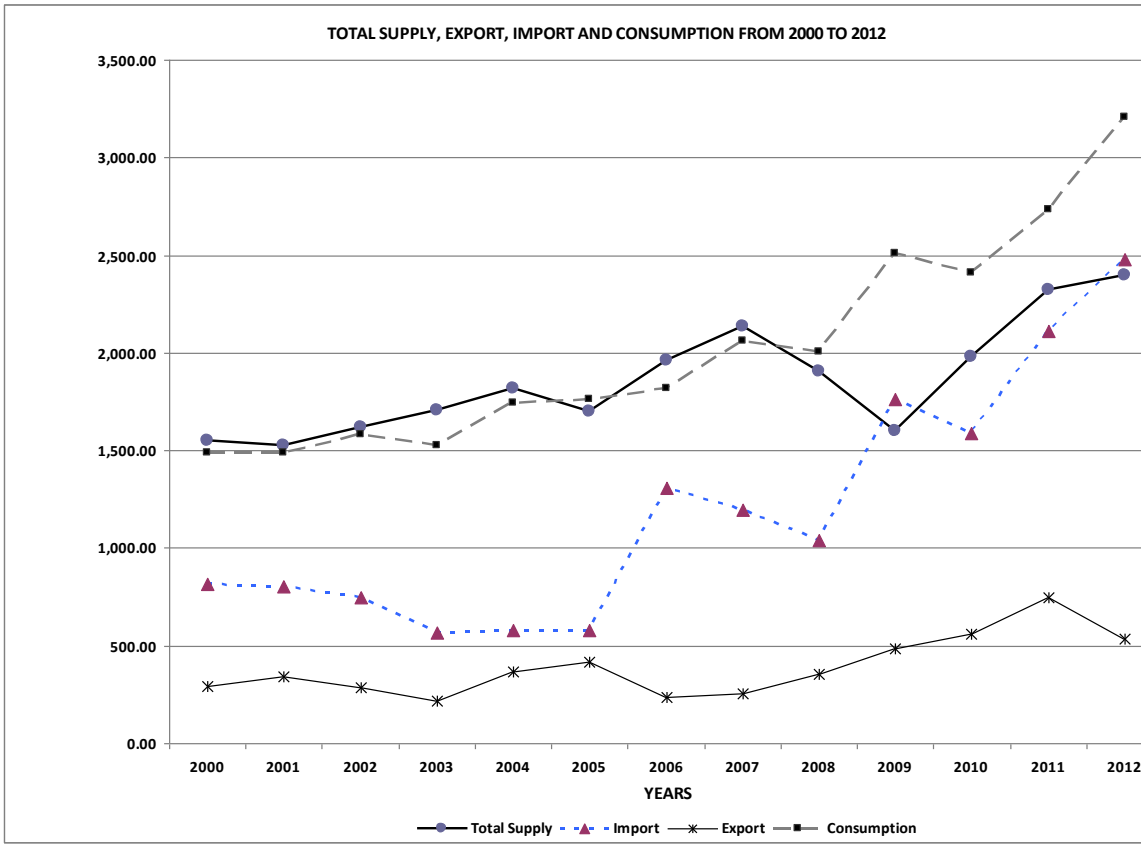

Figure 3.Total oil products supplied from 2000 - 2012

[41] such as "V-power" marketed by one of the major oil marketers.

Total national petroleum stocks or inventories in December, 2012 averaged 120,000 tonnes per week compared to 224,880 tonnes the previous year *(see Table 13*).

Table 13. National petroleum stocks as at 19 December, 2011 and 17 December, 2012.

OIL AND PRODUCTS	STOCKS*		Estimated weeks to last according to NPA	
	2011	2012	2011	2012
	Tonnes			
Crude oil	0	0	0	0
Gasoline	104,414	33,898	5.8	1.5
Premix	740	745	8.5	0.6 *(~4 days)*
Kerosene	2,902	1,048	2.6	1.3
ATK	8,785	10,640	3.0	3.8
Gas oil	104,539	60,164	3.5	1.8
LPG	3,500	4,700	0.7 *(4-5 days)*	0.8 *(5-6 days)*
Total	**224,880**	**111,195**		

**Nearest whole number; NA – Data Not available*
NPA-National Petroleum Authority; EC-Energy Commission
Data adapted from NPA source.

Fuel supply security and erratic fuel prices have advised countries to set up strategic stocks both for crude oil and refined products. Most developed countries, for instance, the OECD[42] members have agreed on a minimum of six months of strategic stocks.

Ghana decided on a similar measure in the 1990s and is supposed to maintain three weeks of strategic stocks of refined products on the average but from the above (*see Table 13*) the situation seems to becoming more challenging. Among the long term strategy recommended under the SNEP 2006-2020 was to expand the strategic stock to include crude oil but the country still keeps zero strategic stocks of crude.

Most gasoline formulas when bought from open market are cracked petroleum products, meaning coming from the cracker units of refinery instead of straight-runs. Cracked gasoline and products have relatively short lifespan, usually not more than three months compared to straight-run products. This also means such cracked products must be used within three months of their storage to avoid gum formation. Straight-run gasoline and products last longer but more expensive. Crude oil storage however has the comparative advantage of longer lifespan than the products.

[42] OECD is Organisation for Economic Cooperation and Development.

2.2 2012 forecast and actuals

Table 14 presents the forecast and the actuals for 2012.

Table 14. Yearly average crude oil prices for 2012: Forecast and Actuals

	Ghana	WTI Gulf Coast/ United States	Brent Crude North Sea/ United Kingdom
Forecast	120-130	100-106	120-130
Actual	113	93.3	112

Source: Bank of Ghana, www.LondonGasPrice.com, www.tradingnrg.com

Ghana's total crude oil import in 2012 was 1.21 million tonnes and as usual came largely from Nigeria (an OPEC country).

Crude oil for refinery operation continued to dwindle since 2010. Just about 506,000 tonnes were refined at Tema Oil Refinery (TOR) in 2012 compared to the local refinery capacity of about two (2) million tonnes per annum. In 2011, about the one (1) million tonnes of oil was refined at TOR. In addition, the 2012 crude for refinery operations was far lower than expected in the light of our forecast of 1.6-1.9 million tonnes (12-14 million barrels) as required for 2012.

Except for diesel, our forecasts for 2012 were within actual products supplied to the economy (*see Table 15*).

Table 15. Comparing major petroleum products consumption in Ghana in 2011 and 2012[43]

PRODUCTS	2011 CONSUMPTION			2012 CONSUMPTION		
	1000 Tonnes		Net /shortfall	1000 Tonnes		Net /shortfall
	Forecast	Actual	1000 Tonnes	Forecast	Actual	1000 Tonnes
Gasoline	800-850	852.2	2.2	850 - 870	992.7	122-143
Diesel	1,600-1,700	1,511.5	(88.5-188.5)	1,600 - 1,700	1,361.3	239-339
Kerosene /ATK	250-300	197.7	(52.3-102.3)	200 - 230	214	14-16
LPG	220-250	214.5	(5.5-35.5)	250 - 300	268.5	18.5-31.5
Total	***2,820-3,050***	***2,775.9***	***(146.3-236.3)***	***2,900 3,100***	***2,836.5***	***63,5-263.5***

NB: Total diesel consumption includes sales to the mining companies and bunkering.
Total gasoline consumption includes premix and other premium formulations.
Petroleum supply shortfall in brackets- red

Despite improvement in our oil product forecast for 2012, shortages of LPG were apparent during the year, though somehow better than in 2011. Demand for LPG would continue to

[43] In this analysis, products supplied to the economy were assumed to be consumed.

grow considering the seemingly large number of vehicles switch from gasoline to LPG (*see Figures 4 and 5*).

Significant increases in retail prices of LPG might have once again helped in retarding its vehicular consumption.

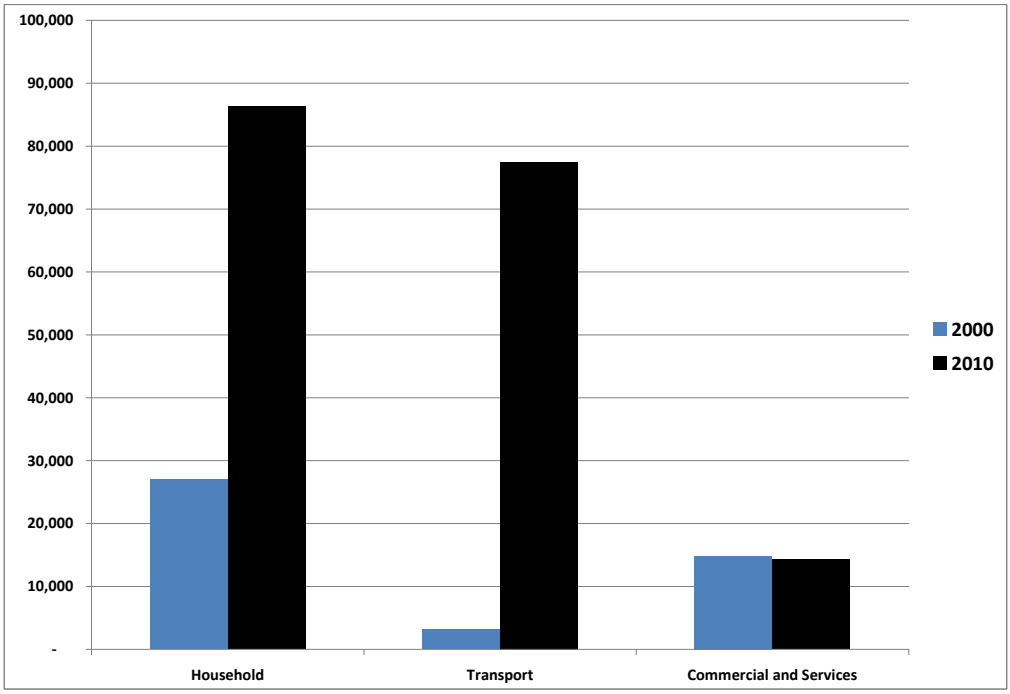

Figure 4. LPG consumption in tonnes for 2000 and 2010

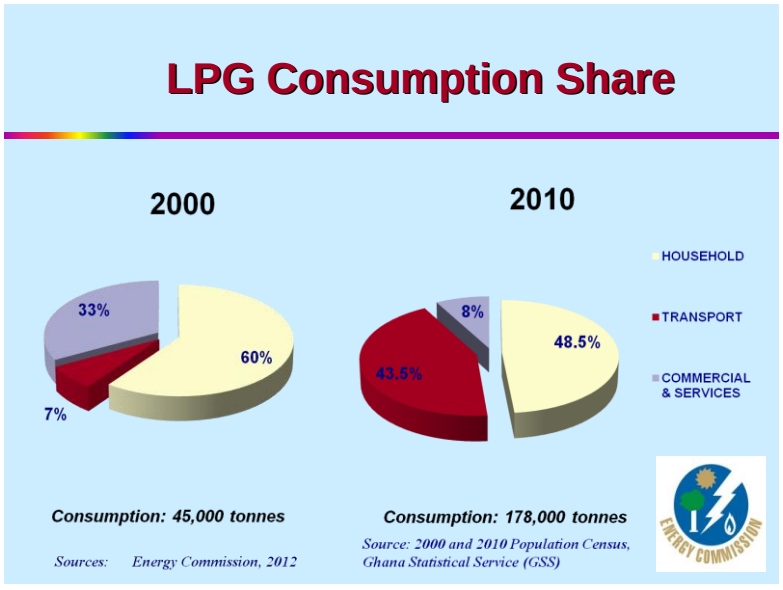

Figure 5. LPG consumption shares for 2000 and 2010

Household fuel use

Household incomes have apparently doubled since 2000 *(see Figure 6*).

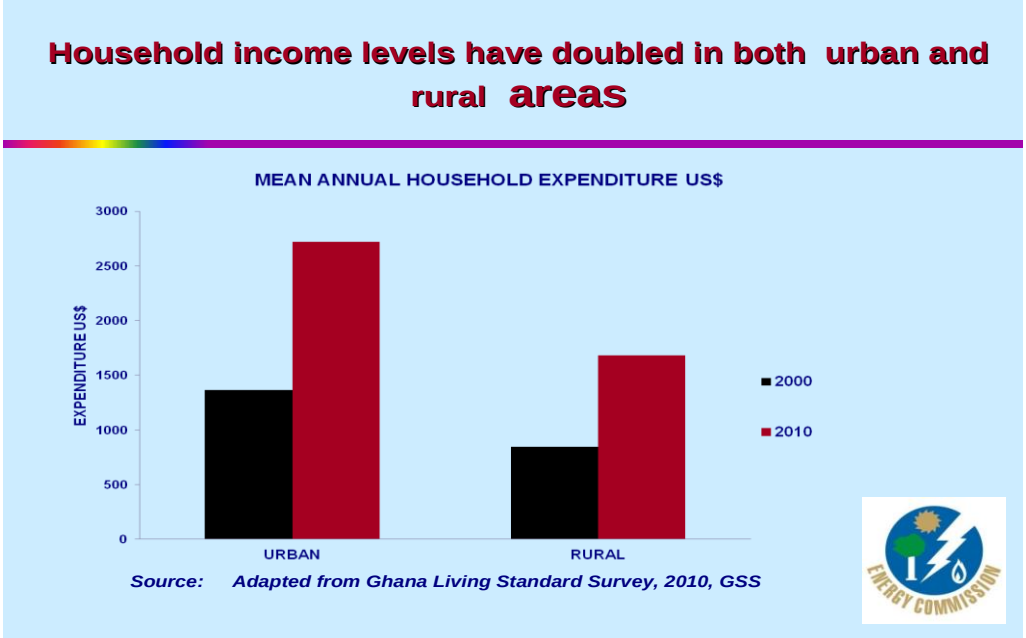

Figure 6. Household incomes in 2000 and 2010 for urban and rural areas

The improvement in household incomes over the past decade is apparently manifesting in the shift from woodfuels and kerosene to LPG for home cooking. (*see Table 16*).

Table 16. Energy for Household Cooking in 2000 and 2010.

Energy source	2000			2010		
	National	Urban	Rural	National	Urban	Rural
Percentage Penetration						
LPG	**6.2**	*11.8*	*1.1*	**18.2**	*41.5*	*4.8*
Charcoal	**30.0**	*54.3*	*8.2*	**33.7**	*74.6*	*15.9*
Firewood	**55.8**	*22.9*	*85.2*	**40.2**	*26.7.*	*73.4*
Kerosene	**2.0**	*2.6*	*1.4*	**0.5**	*1.1*	*0.3*
Electricity	1.1	*2.0*	*0.4*	0.5	*1.1*	*0.3*

Source: 2000 and 2010 National population census, Ghana Statistical Services

From **Table 16** again, cooking with electricity even though already marginal had also dropped by half by 2010, most probably to due its relatively high cost.

It is clear from **Table 17**, that for a developing economy like Ghana, economic growth is directly and strongly related to injection of adequate energy. The fall in GDP growth in 2012

had been attributed to the fall in oil production and subsequently revenues from it compared to 2011.

Table 17. Ghana's Oil Imports, costs and GDP growth compared

Year	Crude oil imported (million tonnes)	Products imported (1000 tonnes)	Petroleum imported in US$1000 (cif)	Average Crude oil price	Real GDP at 2006 constant prices Million GH Cedis	Real GDP growth Rate
2006	1.71	906	1,686	66	18,705	6.4%
2007	2.05	1,200	2,145	73	19,913	5.7%
2008	1.98	1,096	2,413	98	21,592	7.3%
2009	0.98	1,890	1,472	62	22,598	6.3%
2010	1.66	1,450	2,134	80	25,129	8%
2011	1.53	2,075	3,159	111	29, 100*	14.4% *(Non-oil:8%)*
2012	1.21	2,478	>3,200*	113	31,500*	*7.9-8.1%

** Estimated*

Data source: Ghana in figures, GSS-2008, Bank of Ghana, December 2012, Ghana Statistical Services, 2013

Inadequate natural gas for power generation would demand increase in oil supply as the most viable option. Oil is however about two-three times more expensive than gas. Thus without adequate revenues to augment the oil supply for public/grid electricity generation, private generation largely via gensets would rise with corresponding increase in diesel requirement.

With the projected in drop in gold prices and the insufficient and relatively high cost of power in 2013, GDP growth for 2013 is likely to slow down further compared to 2011.

2.3 Forecast for 2013

The year 2012 was faced with the aftermath of the Fukushima (Japan) energy crisis. The Arab Spring which started two years ago has apparently died except for the Syrian crisis which is still on-going and in the forefront. Following closely is the Iranian nuclear crisis. Military experts speculation that there could be a war between Israel and Iran in 2012 even tough did not materialise, the threat is not entirely gone. Impact of geopolitics is still relevant in 2013, so also are the rising oil production costs, such as rising labour and material costs, and the shift to increasingly challenging operating areas, such as the deep- and ultra- deep-waters as in the Jubilee fields, which have emerged recently as factors in the increasing record oil price levels since 2011.

The main driver for oil forecast in 2013 therefore is still going to be a **mix of geopolitics** and **petroleum demand supply fundamentals**, including the speculation factor due to trade in oil futures. The challenge is in determining the right balance.

Geopolitical issues moved to the top of the energy agenda with the start of the political unrest across the Middle East and North Africa in 2011. Similar geo-energy events in 1971 led to nationalization of many international oil companies and the events associated with the Iranian revolution in 1979 led to dramatic increases in oil prices. Thus supply security, geopolitical sensitivity, price volatility would occupy the energy agenda for this year too and would serve as fuel for oil and commodity price speculation.

The **Syrian crisis** somehow is overshadowing the Iranian crisis, but in terms of influence on the petroleum industry, the county is nowhere near Iran. Iran produces between 4-6% of the global oil and gas supplies. She has about 10% of the world's proven oil reserves and 15-16% of the global gas reserves[44]. The country geographically controls the Strait of Hormuz, the sole maritime link between the oil-rich Persian Gulf region and the rest of the world[45]. Tankers carrying an average of 17 million barrels of oil a day from Iraq, Kuwait, Qatar, Saudi Arabia and UAE besides Iran itself, representing about 20% of the global daily supply pass through this vital artery. Any conflict between Israel and Iran could compel the latter to attempt to block the strait and some analysts believe that any sustained blockage could trigger a 30-50% increase in the price of oil and could also trigger a full-scale global recession or depression. The standoff conflict over the Iran's nuclear crisis would try to maintain the high prices of crudes by close of 2013. IMF projects that oil prices may increase by 30% if supplies from Iran are disrupted.

The **South China Sea** is a semi-enclosed portion of the Western Pacific bounded by China to the north, Vietnam to the west, the Philippines to the east and the island of Borneo (shared by Brunei, Indonesia and Malaysia) to the south. Long an important fishing ground as well as commercial shipping routes has been transformed into a cockpit of international friction with the discovery of large oil and gas deposits. Some islands in this energy-rich area are claimed by each of the surrounding countries, including China which claims them all, and has demonstrated a willingness to use military force to assert dominance in the region.

Even though, South China Sea seems remote from Ghana, the global crude oil demand currently would continue to be driven by Asia's demand which has been responsible for 70% of the world energy growth in the past 10-15 years and in which China was responsible for 40% of it. Opposing sides have been flexing their muscles through war of words and war games comprising series of conspicuous military exercises have been conducted in seemingly readiness against each other, particularly with the smaller countries forming alliances and receiving backing from the United States against China. Should the conflict intensify, it can affect the global demand for crude oil.

[44] Syria on the other hand has just about 0.2% of the global oil and gas reserves; contributes just 0.3% of the global oil supplies.

[45] We would encourage readers to check for Strait of Hormuz and the South China Sea from any available global map to save space.

Troubled waters of Africa: Political instability in the horn of Africa, particularly in Somalia generated high rate of piracy in the Gulf of Eden during the last decade which seriously hampered maritime trade including oil cargoes through the Gulf. Piracy levels have greatly reduced thanks to the multi-national naval intervention that was launched in the gulf. The International Maritime Authority[46] has however reported that pirate activities have apparently shifted to West African waters since the beginning of this decade and have exceeded events in the Gulf of Eden. One may recall that the WAGP gas supply was interrupted at the end of August, 2012 following pirate activities in the Togolese waters that month which was said to have caused destruction to a section of the pipeline underneath the Togolese waters. Should the maritime environment be allowed to deteriorate, it would impact to some extent on shipment fees and insurance premium on oil cargoes and consequently global demand and price since the West coast accounts for about 3% of global oil production and shipment. Shipments to Ghana being part of the West coast is likely to be significantly impacted.

Irrespective however of the geopolitical events, demand and supply fundamentals still serve as the major drivers for crude oil price volatility. We elaborate the oil and gas fundamentals as follows:

i. **Global demand growth**: Global oil consumption increased from about 88 million barrels per day in 2011 to an average of 89.6 million barrels per day in 2012 despite its relatively high cost and the escalating tensions in the Middle East[47].. The world economy is expected to expand by 3.6% in 2013 from 3.3% in 2012, a mere 0.3 percentage point increase over the previous year, which is largely due to economic contraction in the Eurozone[48].

   Consumption in 2013 is therefore expected to be at an average of 90.5 million barrels per day, down from 90.6-90.7 million barrels per day previously forecasted by other major experts[49].

   Higher oil forecast is made for Japan due to the Fukushima nuclear power accident which knocked out about 2% from her entire power capacity of 279 GW. Japan's nuclear disaster has also influenced demand for energy in the Far East. The obvious alternative to nuclear in Japan in the short to medium term is thermal plants for power and fuel oil for heating. This means the country would have to buy more LNG (liquefied natural gas), oil and coal to make up the nuclear energy loss. These could push up the price of oil and natural gas consequently.

ii. **U.S. economy**: Despite the economic downturn, the United States is still the largest and the most important economy in the world and was still responsible for about 20% of the global economy in 2012 as in 2011. The economy was projected to grow by

[46] International Maritime Authority, 2012 Annual Report, published, 2013.
[47] 89.9 million by IEA 2011 Market report, February 2012.
[48] IMF January Update, 2012.
[49] IEA Oil Market report, 2013; U.S EIA 2013 Short term Energy Outlook, March 2013.

1.8% in 2012 but expanded 2.2%. IMF has revised downwards its projection for U.S GDP growth from 2% to 1.7% for 2013, even though the US administration is maintaining its forecast of 2.4% for the country for this year. Experts forecast an average crude oil price range of $107-109 per barrel for Brent and $92-97 per barrel for West Texas Intermediate (WTI)[50].

iii. **Euro-zone economic quakes**: The Euro-zone economy which is a key player in consuming crude oil is as large as that of the United States and for that matter equally important comprising about 21% of the global economy. However, it is still threatened by economic and political events in southern Europe, namely Greece, Spain, Italy, Portugal and Cyprus. Europe is also directly and more affected by the geopolitical events in the Middle East and North Africa, since it gets most of its supplies from the affected regions than the United States. In line with the weak economic outlook, European oil demand is expected to decline further in 2013.

Experts estimate an average Brent crude price in Europe to range from $107 -109 per barrel for most part of 2013, depending upon OECD[51] member countries' interventions using their strategic reserve stocks.

Meeting the global demand: The market would need between 800,000-900,000 **barrels a day** extra to meet the global demand in 2013. Meeting this excess demand would come from production in OPEC and Non-OPEC countries as well as existing inventories and strategic stocks just as in the previous years. Significant growth in supply is expected to occur in Iraq, Caucuses region of Russia, China and West Africa. Libya and South Sudan are also expected to contribute significantly to the global supply, with the apparent return of peace to their countries after last year's political crisis. Production in North America would continue to increase with growing production from onshore shale formations and the Canadian tar oil sands.

Global oil production share is expected to be 41% coming from OPEC, 11% coming from Russia, 13% from the United States and the remaining 35% coming from the remaining Non-OPEC countries[52].

iv. **Total supply from OPEC countries** was projected to decline in 2012 due to the prevailing crisis in the region, but rather increased from about 25 million barrels a day to 30 million barrels a day in the year[53]. In fact, its production quota rose to about 31 million barrels per day in January 2012, the highest since 2008 ostensibly to take advantage of the prevailing high oil prices.

OPEC is responsible for about 40% of the world crude oil supply. Its members serve as the "swing" producers in the world market, since they largely possess surplus or

[50] BMI, January 2013; US EIA February, 2013
[51] Organisation for Economic Cooperation and Development usually referred to as rich countries' club.
[52] BMI Global Oil & Gas news, January, 2013.
[53] The quota was set in 2008 by OPEC. www.opec.org.

"spare" oil production capacity estimated at 2.82 million barrels a day by close of 2011. OPEC maintains a production quota of 24.845 million barrels a day[54]. Increasing prices however means more revenue for producing countries and for that matter plays into the interest of some of the member countries. Therefore at a meeting in December 2012, the cartel decided to keep production capped at a three-year high of 30 million barrels per day.

Iraqi exports would compensate for any potential drop in supply from Iran and Venezuela.

v. **Price speculation** due to activities of traders in oil futures cannot be ignored, unscientific, though**.** Current fundamentals could place the global oil price range to between US$80-90 per barrel but speculation is estimated to account for 20-26% of the current world market oil price range [55].

Experts speculate that the prevailing uphill prices are not sustainable and could send the fragile global economy into recession as occurred in 2008.

Therefore, in order to curb the increasing prices, we expect interventions from OECD countries[56] and perhaps from major OPEC members like Saudi Arabia which has adequate spare production capacity and the reserves to do so. Commercial oil inventories or stocks held by OECD stood at 2.61-2.64 billion barrels equivalent to about 57 days of their supply.

On the other hand, high prices give field operators an opportunity to produce more oil from enhance oil recovery (EOR), unconventional sources as well as from deeper and offshore depths.

Forecast for Ghana: Since Ghana's supplies largely come from Nigeria (an OPEC country) and Equatorial Guinea (a non-OPEC country) all in West Africa, we forecast that average Brent crude oil price that Ghana buys would be $108-110 per barrel [57] and $98-102 per barrel for other light crudes (*see Table 18*).

Table 18. Forecast for average crude oil prices for 2013

Fuel brand	**Ghana**	**United States** (WTI and NYMEX)	**Europe**
	US dollars per barrel		
Brent crude	108-110	106-107	107-109
Other light crudes/ U.S refiner	98-102	92-97	97-100

[54] The quota was set in 2008 by OPEC. www.opec.org.
[55] Personal communication with Prof. Krishan Malik, President, Institute of Petroleum Development, Austin Texas and of Department of Petroleum and Geosystems Engineering, The University of Texas at Austin, April, 2011.
[56] Organisation for Economic Cooperation and Development; nicknamed a club of largely upper middle income and developed countries.
[57] With characteristics almost or similar to Brent crude.

As in 2012, we do not expect Ghana to source her crude oil from the Jubilee field, a high premium oil[58]. Rather, it sounds more prudent to use part of Ghana's proceeds from the sales to mitigate the impact of consequential high product prices at home.

For the Jubilee field operations, with technical challenges almost resolved and new wells drilled, production would be maintained at about 100,000 barrels per day reaching between 110,000-120,000 barrels per day by the close of the year[59].

Local petroleum product requirements

Quantities of imported crude oil refined at TOR and products imported to meet shortfall totalled reduced from about 3.2 million tonnes in 2011 to around 2.9 million tonnes in 2012, a drop of about 9%.

With the expected drop in crude oil prices, we estimate that the total crude oil and imported products required for **2013** would increase to **3.0-3.5 million tonnes** in order to meet optimal refinery operations and products for local consumption as well as for exports (*see Table 19*). Crude oil required for refinery operations would vary from **1.6-1.9 million tonnes (11-13 million barrels**) during the year, depending upon the availability of the Tema Oil Refinery and its auxiliary units. The remaining **1.4-1.6 million tonnes** balance would be imported products.

Table 19 presents estimated the total products required for 2013.

Table 19. Petroleum product forecast for 2013.

PRODUCT	National supply requirement	Exports included
	Tonnes	
Total Gasoline	850,000 - 970,000	1,000,000
Total Diesel	1,600,000 - 1,700,000	1,850,000
Kerosene/ATK	200,000 - 230,000	300,000
LPG	250,000 - 300,000	350,000
Total	***3,000,000 3,200,000***	***3,500,000***

NB: Total gasoline includes Premix;
Total diesel includes supplies to the mining companies and bunkering

Capacity utilisation at Tema Oil Refinery (TOR) in 2012 was just around 25%, about one third of what was used in 2011. However, based on international standards, 95% capacity utilization is required for refineries to achieve economic viability. TOR is supposed to refine all the crude oil needs of the country, except for consignments meant for power generation. It

[58] With API equal or greater than 37.
[59] Tullow Operational Update, December, 2012.

comprises a Crude Distillation Unit (CDU) of production capacity 45,000 barrels per day (bpd) and a 14,000 bpd Residual Fluid Catalytic Cracker (RFCC) unit to process RFO, a by-product of crude oil processed by the CDU, into diesel, gasoline and LPG.

The country's annual petroleum requirement has however far exceeded the capacity of TOR by about 50%, assuming TOR is operating at over 90% capacity utilisation.

LPG supply: Half of the total LPG requirement could be met if TOR is operating at over 90% capacity on the average during the year (*see Table 20*). This would also reduce the LPG import requirement to half of the national demand.

However, limited local production means about two-thirds or more of the LPG national requirement would be imported. Cross-subsidization of the ex-depot price of LPG means gasoline and diesel are made to carry most of the tax and levy burden[60]. The shift from gasoline to LPG by vehicle users also suggests that the necessary revenues expected are not generated from the gasoline sales to augment or beef up LPG imports[61].

Table 20. Operating performance of Tema Oil Refinery with and without the RFCC[62]

	Without RFCC		With RFCC	
	Tonne per year	**Weight %**	**Tonne per year**	**Weight %**
Technical operational capacity in tonnes	1,995,000	100	1,995,000	100
Products				
LPG	26,136	1.3	114,944	5.8
Gasoline	300,273	15.1	580,615	29.1
Naphtha	38,595	1.9	0	1.9
ATK/kerosene	270,629	13.6	270,629	13.6
Diesel	716,206	35.9	798,034	40.0
Fuel Oil	582,994	29.2	71,575	3.6
Consumption/Losses	60,379	3.0	119,930	6.0

Adapted from Tema Oil Refinery data

Total national LPG storage capacity is also a challenge. In summary, storage limitations and insufficient revenue generation could constrain the supply to less than 300,000 tonnes in 2013. Otherwise, total LPG requirement of the country could exceed 300,000 tonnes up to 350,000 tonnes due to the increasing requirement by the transport sector as fuel, considering

[60] Gasoline carries most of the levies and taxes, whilst LPG is taxed for only excise duty and debt recovery levy.

[61] LPG price for vehicular fuel is slightly higher than for domestic cylinders but still far lower in energy terms when compared to gasoline.

[62] RFCC is Residual Fuel Catalytic Cracker.

that demand growth for LPG as fuel for transport in southern sector had ranged from 11-26% per year since 2006[63].

Additional LPG supplies for the country is expected from processing the wet associated gas from the Jubilee field, when the gas processing facility becomes operational by end of this year. For instance, processing 160 mmscfd of the wet gas would yield about 1,000 tonnes of LPG a day, which would be enough to meet the country's short term; 1-2 years demand[64].

Priority Issues

We reiterate some of the issues raised in the earlier Outlooks since they were hardly implemented.

i. Include Crude oil in strategic stocks

We are of the opinion that existing strategic stock based on products storage alone is more expensive to stockpile and in addition limits the country's ability to take advantage of any falling oil prices to the fullest. Besides, products have limited shelf life.

After 1983, developed countries' petroleum strategic storage has been shifting towards crude oil. As at the end of 2008, the United States petroleum stocks totaled 1.7 billion barrels, 59% crude oil and 41% products.[65]

ii. Expand refinery capacity as soon as possible

Crude oil in stock would still have to be refined into usable end products. With the commercial oil production, Ghana stands to gain immensely if immediate steps are taken to expand the refinery capacity of the country. It costs less to import crude oil for refining locally than importing the finished products as shown in **Table 21**.

Table 21. International Price Scale: Ratio of prices of refined product against crude oil

Products	F.O.B	C.I.F*
Crude oil	1.0	-
Gasoline	1.3	1.5 – 1.6
Diesel	1.25	1.3 – 1.4
Kerosene/ATK	1.35	1.4 – 1.5
Fuel oil	0.6 – 0.7	0.8 – 0.9
LPG	1.4	1.5 – 1.7

* *Depending upon distance for delivery*

[63] Energy Commission (2011), Liquefied Petroleum Consumption survey, 2003-2007. Energy Survey in Households, Industries, Commercial and Services.
[64] Assuming short term is 1-2 years; 2014-2015 and medium term; 2014-1017.
[65] EIA, 2009

Ghana announced her intention to expand the Tema Oil Refinery (TOR) as well as build a new refinery in the late 1990s but no construction has since started.

Export opportunities in the West Africa sub-region abounds and an expanded refining capacity would therefore position the country to take advantage of the inadequate refinery capacity in West Africa. Total consumption in non-refinery countries[66] in West Africa has exceeded 80,000 barrels per day (*about 4 million tonnes per annum*). Besides, Nigeria has total refinery capacity of about 600,000 BPD (about 20 million tonnes) but production has been below 50% capacity due largely to operational difficulties. Ghana could quickly expand TOR whilst it makes plans to construct a new refinery to meet local demand as well as targeting the economies within the sub-region, particularly those without refineries and at least, capturing 50% of the market by 2020. Since, building a new refinery of about100,000 barrels per day capacity takes between 3–5 years, such a facility in Ghana could be operational by 2017 if construction starts by 2014.

With the limited refining capacity within the West African sub-region for the short-to-medium term, it is prudent that the right and attractive investment climate is created to encourage investment in new refineries in the country.

It must however be noted that the profitability of refinery operations is very sensitive to the capacity utilisation; 90% capacity utilisation has been accepted as benchmark for economic operations of most refineries. It will therefore economically wise to locate such say a 100,000 barrel per day refinery plant in the Export Processing Zone (EPZ) with export market as part of its target.

iii. LPG Supply

Increasing refinery capacity and revamping of TOR would increase the production of LPG at TOR. Limited storage capacity however would continue to constrain local distribution and access.

2.4 Recommendations

We reiterate the recommendations made in 2012 that[67]

i. *BOST[68] initiate steps to include storage of crude oil as part of the strategic stock of the country as soon as possible. Storing crude oil is quicker, far cheaper, stable and more durable compared to storing products.*

ii. *National Petroleum Authority encourages the OMCs to set up more LPG distribution centres to increase access and consumption.*

[66] Benin, Burkina Faso, The Gambia, Guinea Bissau, Equatorial Guinea, Liberia, Niger, Mali, Mauritania, Togo
[67] SNEP, 2006-2020, Energy Commission, www.energycom.gov.gh/documents
[68] Bulk Oil Storage and Transport company

3.0 Petroleum Subsector: Natural Gas

3.1 Overview of natural gas supply in 2012

Total WAGP gas flow in 2012 was 15,491,670 MMBtu (15,492 mmscf); about 74% destined to the thermal plants in Tema and the rest to Takoradi *(see Figure 7).* The average daily gas flow was 64,537 MMBtu (~65 mmscf); average for the Tema and Takoradi thermal plants were 45,291 and 21,499 MMBtu per day[69].

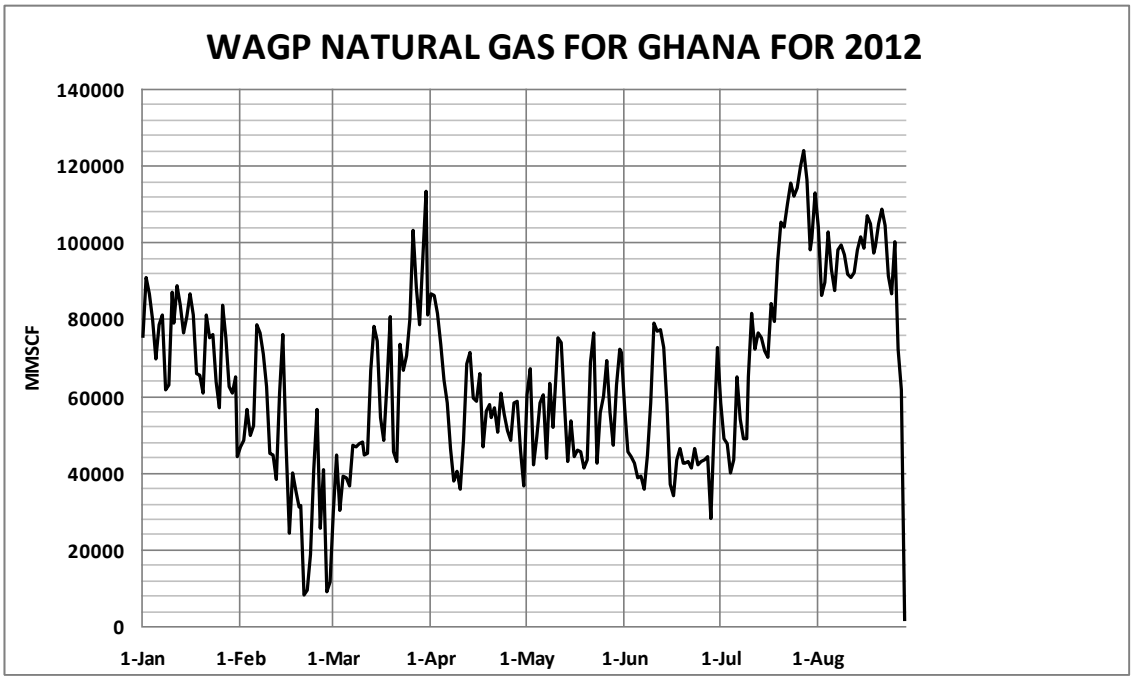

Figure 7. Total WAGP gas supply for Ghana in 2012

3.2 2012 forecast and actuals

We projected that despite the encouraging flows in 2011, Ghana was not likely to see the same fortune in 2012 in the light of growing gas demand and political developments in Nigeria. The pipeline after the August, 2012 accident has been repaired but still no gas flowing as end of first quarter of 2013 draws nigh. Average WAGP gas flow per day for the period of flow was 65 mmscfd compared to about 95 mmscfd in 2011[70].

In 2012, the WAPCo tariff for transporting natural gas via the West African Gas Pipeline was $4.175 per MMBtu from $3.963 per MMBtu in 2011 for Foundation customers and $4.282

[69] Source: data received from WAPCo, 2013.
[70] Enquiries from WAGPCo, January 2013.

per MMBtu from $4.065 per MMBtu in 2011 for Standard customers. The 2012 WAGP Gas transportation tariff was within our forecast of $4.08-4.19 per MMBtu.

Average WAGP gas price in 2012 was $2.587 per MMBtu compared to $2.454 per MMBtu in 2011. The total delivery price in 2012 was $8.188 per MMBtu [71] (*see Table 22 for details*).

Table 22. WAGP Delivered Gas Price Components

Details	Customer Price	
	Foundation	Standard
	$/MMbtu	
Gas Purchase	2.5870	N/A
ELPS Transport	1.2271	N/A
WAGP Transport	4.1752	4.2818
WAGP Credit Support Charge	0.1139	N/A
WAGPA Charge	0.0600	0.0600
Delivery or shipper fee	0.1000	N/A
Pipeline Protection Zone charge	0.0250	0.0250
Fuel Gas - Commodity	2.5870	N/A
Fuel Gas - ELPS Transport	1.2271	N/A
Shipper Fee	0.1000	N/A
Delivered Gas Price ($/MMbtu)[72]	**8.1882**	N/A

Source: Adapted from WAPCo, 2013

Both the gas and the total delivery prices fell within our projected ranges of $2.53-2.55 for the gas and $8-9 per MMBtu for total delivery respectively.

3.3 Forecast for 2013 and beyond

For 2013, the WAGP transport fee is likely to be adjusted to $4.20-4.30 per MMBtu owing to the repairs due to the August, 2012 pirate attack. ELPS transport charge may also increase by 20-40% over 2012 fee due to major rehabilitation works to stabilise the ELPS system in Lagos and upward adjustment of insurance premium due to the accident. Nevertheless, we still expect the total gas delivery price to stay within **$8-9 per MMBtu** due to the expected fall in crude oil prices which the gas price is indexed to.

Comparatively, average spot (Henry Hub) price in the United States has been projected to increase to $3.52 per MMBtu whilst average delivery price in Europe is expected to stay within $8.80-8.90 per MMBtu during the year (*see Table 23*) [73].

[71] Source: WAPCo, 2013. Communications with the statistical personnel.

[72] Delivered gas price is not an absolute sum of the listed charges. It is usually the total less the repetitive charges. It also does not include the Credit Support Charge component.

Table 23. Average delivery gas prices in Ghana (WAGP), United States (Henry Hub), and Europe (the North Sea).

Year	WAGP/ Ghana	Henry Hub/ United States	Northsea Europe/
	U.S dollars per MMBtu *LNG import prices in italic brackets*		
2011	6.56	3.59	8.70 *(11.97)*
2012	8.19	2.75	8.90 *(11.79*
2013	**8.50-9.00**	**3.52** ***(6)***	**8.80** ***(10.80)***

Source: Bank of Ghana, LondonGasPrice.com, tradingnrg.com

Securing adequate supply of gas is fundamental to improving availability as well as providing relatively affordable electricity price. Restoring the high supply levels Ghana had in 2011 up to August 2012, again would depend upon demand and political developments in Nigeria due to supply constraints in Nigeria itself (*see Figure 8*).

Existing and on-going power projects in Nigeria if all goes well as planned could expand the country's installed capacity to about 13,000 MW by 2016 and 15,000 MW by 2020[74]. The country achieved a generating capacity of 4,350 MW by end of 2012, a feat attributed to more gas being made available last year. According to NERC[75], the country is on course to achieve a generation capacity of 7,000 MW by close of 2013. Should this ambition be aggressively pursued, there would be a greater strain on the existing supply situation. Nigeria is struggling to achieve its domestic supply and export plans. Supply requirement totals about 5 billion cubic feet per day (bcfd) for domestic consumption, LNG contractual shipments and WAGP commitments. The country needs to develop new fields and bring them on line to meet the projected demand but experts in the industry do not expect even up to half supply to be realised until 2016-2017 *(see Figure 8)*.

The current policy of the Nigeria government somehow seems to be meeting local gas demand first before considering exports to neighbouring countries.

[73] Spot prices usually do not include transportation cost.
[74] Energy Commission of Nigeria, website news update, 1st Quarter, 2013.
[75] Nigeria Electricity Regulatory Commission, Nigeria Power Report, first quarter 2013.

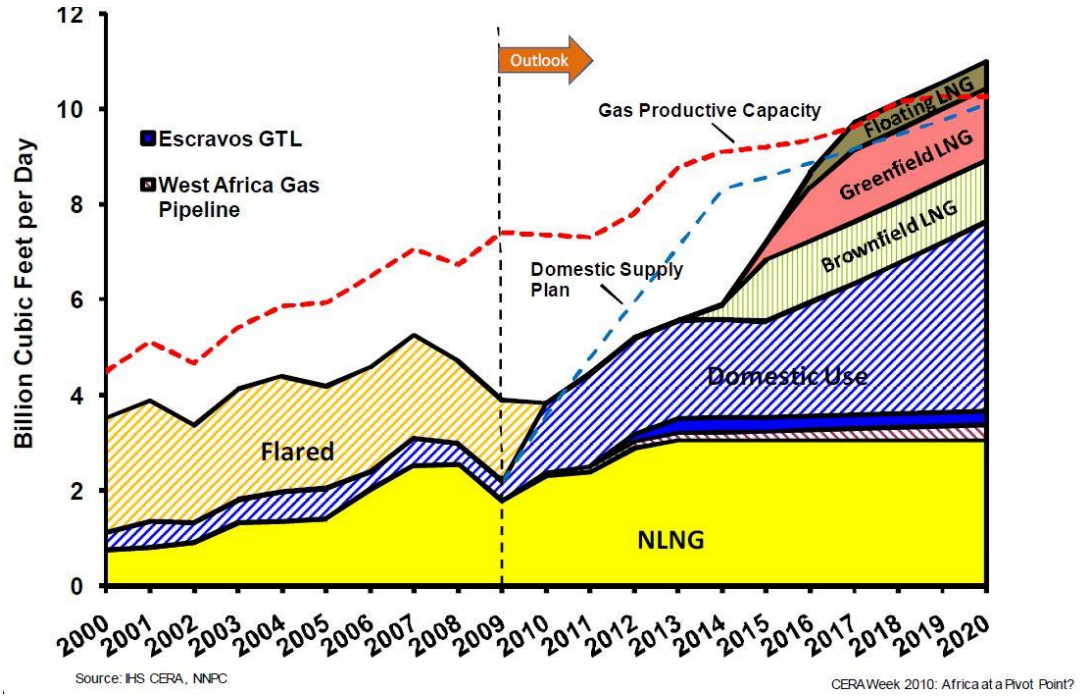

Figure 8. Projected Nigerian natural gas supply plan. Courtesy of CERA, 2010

Unlike crude oil, the geopolitical events in the North Africa and Middle East have affected largely natural gas supplies to Europe. International supply to North America is the least affected, thanks to the region's own production from shale gas fields. Besides the high impact due to the North African crisis, Europe is yet to commence significant commercial operations in its shale gas formations due to strong debate on environmental concerns.

3.4 Alternative natural gas supply sources

3.4.1 Supply from the Jubilee field

Associated gas produced as a result of the daily oil production in 2012 was about the same as 2011, i.e. 91 mmscfd. About 9.5% was used as fuel for on-board operations compared to 4-8% in 2011. Associated gas flared had however reduced further to less than 3% compared to about 5% in 2011 (*see Figure 9*).

Associated gas flared was about 96% at the beginning of commercial production in 2010. This is also an indication that the field operators are understanding the geology of the formations and so are confident in doing more re-injection of the gas. There is however still

some uncertainties as to how long the geological formation would allow re-injection beyond 8-24 months of operation.

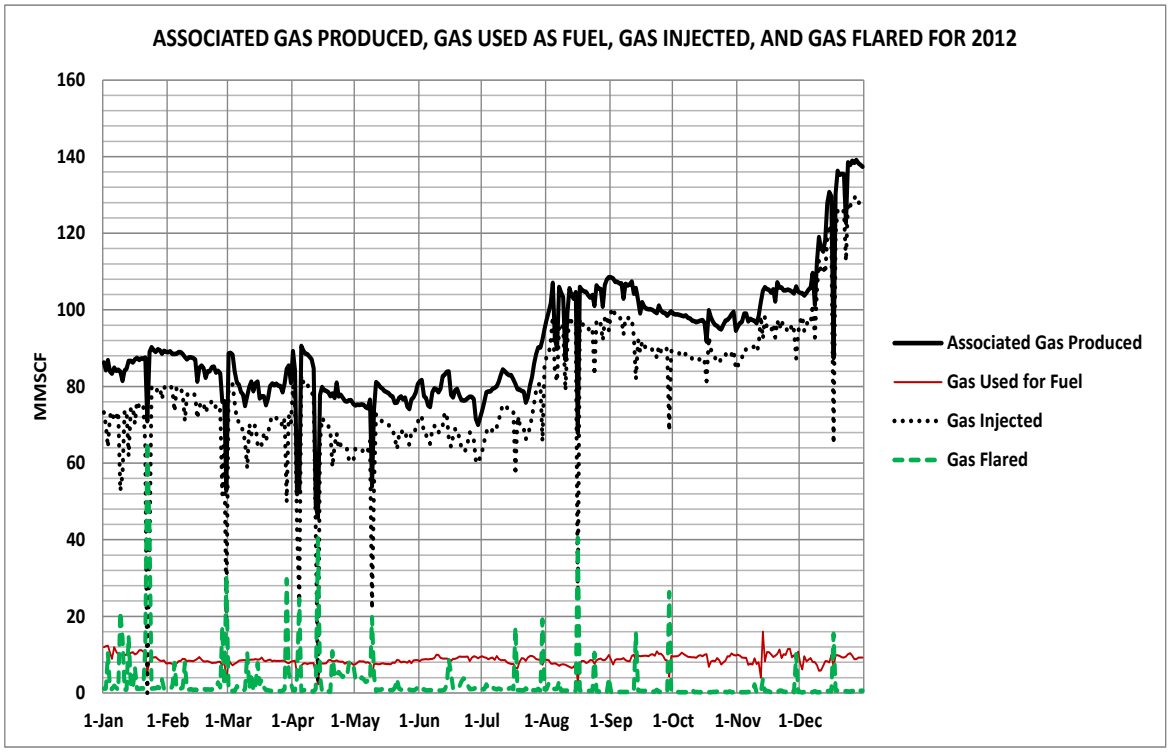

Figure 9. Jubilee field daily gas production in 2012

Pipeline infrastructure to transport the associated gas being produced from the Jubilee fields, from the FPSO[76], onshore for processing is almost complete; the marine-portion is 100% complete and the onshore section left is over 82% complete. Reliable indications from the field suggest that the gas processing plant could be operational by last quarter of 2013, depending upon timely and adequate financing and provided scheduled implementation activities are followed through. Expected net average gas supply would range between 60-100 mmscfd.

Nevertheless, there is still a fact that the associated gas from the Jubilee field even at 120 mmscfd alone would not be adequate to meet the current gas requirements for medium-to-long term. For this reason, alternative supply options would have to be looked at.

[76] Floating Production, Storage and Offloading (FPSO) Kwame Nkrumah MV 21

3.4.2 Supply from LNG re-gas facility

There are however opportunities for LNG supply through the following sources:

- Floating Re-gasification plants using grounded LNG vessels which have retired from services.
- Temporary or stop-gap through "Energy Bridge Re-gasification Vessels" (EBRVs)
- Permanent LNG re-gasification plants.

For N-Gas of Nigeria to limit gas supply to WAGP at contract volume of 128 mmscfd instead of the full capacity of 440 mmscfd as originally agreed in the supply contract is of concern but not hopeless[77]. The supply balance of 312 mmscfd reinforces the opportunity for the development of a viable LNG terminal. Furthermore, the un-utilised space in the pipeline can be used as gas storage through a technique known as "line packing" to serve as back-up for the potentially alternative gas supply sources but to only to offset very short interruptions in supply.

Under the WAGP sales agreement, **Open access** to the pipeline, i.e. allowing third parties to access the pipeline if convenient was supposed to commence last year.

About 43 LNG regas plants of 100-200 mmscfd capacity existed globally as at 2010. Eleven new ones have either been approved or under construction and 22 new projects were announced (Annex 2). Of course larger capacity LNG regas plants are also available.

With significant commercial shale gas discovered in North America demand pressure on global supplies is expected to reduce and natural gas global market average spot price is expected to stay within US$5.5-6.5 per MMBtu for the next five years[78].

Deployment of LNG regas facility

Permanent LNG discharge/re-gasification terminal

Development of permanent LNG re-gasification plant of 100-200 mmscfd capacity however require at least **three-four** years even if a project is approved and money is available today.

Nevertheless, for a permanent LNG regas facility, supplies to Ivory Coast could be included as a medium-to-long term potential market to supplement dwindling indigenous supply in that country. One should also not be surprised, if such a project end up supplying gas to neighbouring Togo and Benin also in the long term, provided the WAGP facility allows reverse directional flow.

[77] Energy Commission source
[78] International Energy Agency (IEA), medium to long term forecast.

Energy Bridge Regasification Vessels

The energy bridge re-gasification is the one that can be delivered in the shortest possible time; i.e. **within a year**. Energy Bridge Regasification Vessels, or EBRVs™, are purpose-built LNG tankers that incorporate on-board equipment for the vapourisation of LNG and delivery of high pressure natural gas. These vessels load in the same manner as standard LNG tankers at traditional liquefaction terminals, and also retain the flexibility to discharge the gas in two distinct ways. These are:

- Through the EBRV's connection with subsea buoy in the hull of the ship; and
- through a high pressure gas manifold located in front of the vessel's LNG loading arms.

The maximum rate of discharge of the natural gas from an EBRV into the deepwater port is determined by a combination of the availability of capacity on downstream pipelines and the regasification capabilities of the facilities located on-board each EBRV.

Floating Re-gasification plants

Average lifetime of most LNG vessels is 25 years. This means LNG vessels built more than 25 years ago have become less competitive for transport services. Such an LNG ship is retired and reconfigured as floating LNG re-gasification facility. Typical LNG ship has capacity of 120,000-125,000 liquid cubic metres (lm^3). The larger the containment the greater the application for floating storage and regasification applications[79]. Some 59 ships built worldwide before 1983 with containment between 122,000-133,000 liquid cubic metres are due for retirement.

Construction of floating regas terminals has rapidly increased since 2005 when the first one was built in Louisiana, USA. Four units were commissioned between February 2007 and August 2008.

Floating Regas facility would take between **one and half-to-two years** to build if a project is approved and money is readily available today, otherwise **up to three years** to allow for initial paper works.

Cost implications of LNG supply option

LNG supply option however would be relatively expensive compared to local or the WAGP gas. Potential LNG supplies are likely to come from cargos from Nigeria and Angola destined for United States and or the European markets. LNG cargoes from Nigeria to the United States would potentially offer the least cost due to the prevailing low gas prices in the

[79] Zeus Liquefied Natural Gas Report, January 28, 2009

latter. Nigeria accounted for 3% of United States' LNG supply in the past but with the existing gluts in the latter, shippers are looking for alternative markets, of course, the bulk would go to the growing Asian market.

Ownership and financing arrangement would also impact significantly on the cost of the delivered gas. Ownership can be Joint Venture - shared cost between a Ghanaian and foreign partners; Public or State Private Partnership (PPP); or facility wholly owned by a foreigner investor.

PPP through state participation by providing sovereign guarantee is likely to reduce cost further due to potential decrease in risk cost.

Table 24 presents a qualitative analysis of likely cost range for the country if such is built within the next two years.

Table 24. Estimated LNG cost range based on cargo shipments from Western Africa to United States and Europe.

LNG Cargo Destination	**Ownership/Financing Arrangement in US dollars per MMBtu***			
	PPP	Joint Venture/ Shared Cost	Operator wholly owned	***Add*** Construction of off-loading/regas berth
From Nigeria en-route to USA	6-7	8-9	9-10	1.0-2.0
From Nigeria en-route to Europe	7-8	9-10	11-12	
From Angola en-route to USA	7-8	9-10	10-11	
From Angola en-route to Europe	8-9	11-12	13-14	

**Assuming operating life time of 5-10 years and minimum delivery volume of 200 mmscfd*

3.4.3 Supply from other domestic fields

Besides the gas from the Jubilee field, more associated gas is expected from other neighbouring fields in the medium to long term, the most prominent being TEN (Tweneboa-Enyenra-Ntomme) field when oil production starts around 2017[80], but this would depend on rate of development of the field which is scheduled to start in 2013. TEN is expected to yield an average of 90 mmscfd for over 20 year operational lifetime.

The Sankofa field, another neighbouring field presents the most significant proven non-associated gas discovery in recent times. Estimated yield is about twice the projected average yield from Jubilee; about 185 mmscfd. Deepwater 'non-associated' however means it would cost more to develop the field. Wellhead price is estimated to be $6-9 per MMBtu compared

[80] Estimated as the commencement year.

to wellhead cost of the Jubilee associated gas which is virtually given to Ghana for free[81]. In all cases, generation from gas supply options including the LNG would be less expensive than any oil-fired option.

The initial natural gas demand at Takoradi Thermal Power Plant if the WAGP pipeline were to be operational in 2006 was 36 mmscfd. With the number of thermal power plants currently installed and expected to be in operation by 2015, the current demand is between **260-290 mmscfd** which is over the breakeven point for a typical 200-250 mmscfd LNG re-gasification facility. Demand is expected to jump up significantly when gas from the other fields discussed are developed and production starts between 2017 and 2018. Gas demand is projected to exceed **800-mmscfd** by 2017 (*see Table 25*)[82].

Meanwhile, total production from all these local fields is expected to range from a minimum of about **80 mmscfd in 2013** and ramp up to a maximum of about **400 mmscfd** by **2018** if developments of the fields are carried out as planned. Total gas supply is not likely to exceed **500 mmscfd by 2020**.

Thus based on the projected electricity demand and estimated gas required by existing power plants plus those under construction and those planned or issued with licences by the Energy Commission, the country is likely to experience gas supply shortfalls right from this year 2013 to 2020. The situation becomes more challenging when industrial demand is included.

Thus the only cost effective gas supply option to quench the shortfall is by LNG import.

In summary, LNG imports would augment domestic gas to make up adequate supplies to meet both power and industry requirement such as for the anticipated production of fertilizers (urea), alcohol (methanol) and other petrochemicals.

In making our forecast for the natural gas up to 2020, we made the following assumptions:

- that industrial use of gas is not likely to be realised until 2015-2016, starting with 5 mmscfd by 2015 to about 50 mmscfd by 2020.
- that a typical urea-fertilizer plant with minimum capacity of 800,000 tonnes per year would require about 50 mmscfd but would not be available until 2017, if construction is even to starts this year-2013.
- that a typical methanol plant with minimum capacity of 800,000 tonnes per year would require about 70 mmscfd but would not be available until 2017, if construction is even to commence this year-2013.

[81] Adapted from the World Bank commissioned report: Natural Gas Pricing Policy for Ghana, Final Report, May 2012, consultant- R. Garcia Consultores S.A
[82] See 2010 Energy Outlook, Energy Commission, 2010.

Table 25. Natural gas forecast for Ghana in mmscfd, 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Min *Power only*	**262**	**313**	**313**	**370**	**840**	**840**	**870**	**870**
Max *Power only*	**289**	**345**	**380**	**446**	**1,128**	**1,128**	**1,140**	**1,140**
Min *Non-power incl.*	**262**	**313**	**318**	**380**	**980**	**990**	**1,030**	**1,040**
Max *Non-power incl.*	**289**	**345**	**388**	**456**	**1,268**	**1,278**	**1,300**	**1,310**
Available annual average supply								
WAGP	***0-40***	***0-100***	***0-120***	***0-120***	***0-120***	***0-120***	***0-120***	***0-120***
Local fields	***5-10***	***60-100***	***80-100***	***80-100***	***200-300***	***300-400***	***300-400***	***400-500***

Source: Energy Commission, 2013

What is urgent at present is for the Government to ensure that the required commercial framework for the development of Sankofa and other new fields are finalized by close of this year–2013 to enable commercial production to commence by 2017. The development of the Sankofa field would require significant fiscal incentives like tax holidays to investors to make it economically viable since unlike oil which could easily be stored and ferried out of the country borders to external market, non-associated gas requires long-term supply commitment before they are developed.

3.5 Recommendation

We thus make following recommendations:

i. *Government proactively creates incentives to encourage investment in LNG regas facility to be built in Ghana at the shortest possible time.*

ii. *Government ensures as a matter of urgency, that the required commercial frameworks for the developments of the TEN and the Sankofa fields are finalized by close of this year – 2013 to enable commercial production in these fields to commence by 2017.*

iii. *Government provides significant attractive fiscal incentives to investors to make the non-associate gas fields economically viable to develop.*

4.0 Woodfuel Subsector: Charcoal demand and prices

With increasing GDP growth over the years, and translating into improvement in household incomes, shift from firewood to cleaner fuels would continue to grow, i.e. from firewood to charcoal to LPG. Inadequate charcoal would push for higher demand in charcoal. More charcoal however translates into more wood required for charcoal production (*see Figure 10*).

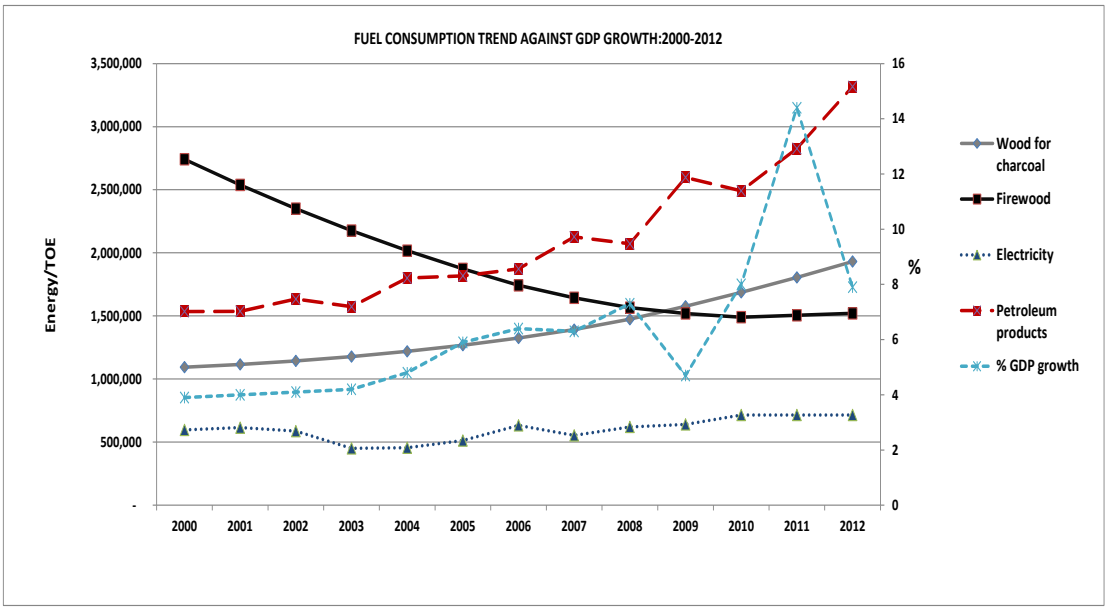

Figure 10. Fuel consumption trend as against GDP growth: 2000-2012

Average prices of charcoal in the country rose from GH¢9 per mini bag and GH¢15 per maxi bag in 2011 to GH¢11 per mini bag and GH¢18 per maxi bag in 2012. The prices at the end first quarter of 2012 were about GH¢10 and GH¢16 per mini- and maxi- bags respectively. These were average increments of 22% and 20% for mini-bags and for maxi bags respectively.

The high-price regions for 2012 were Central and Western regions with the former being the most expensive charcoal region. Central and Greater Accra regions were apparently the high-price regions in 2011 (*see Table 26*).

The low-price regions in 2012 were Ashanti, Brong-Ahafo and Northern Regions. There was a drop in the average price of mini-bag in Northern Region. Greater Accra Region had a slight drop in the average price of maxi bag.

Average charcoal price for mini-bag however more than doubled in Upper East and West Regions. Eastern and Western Regions also experienced significant charcoal price increment in 2012 (*see Table 26).*

Table 26. Average price per mini and maxi bags of charcoal in the regions for 2011 and 2012[83].

Region	Average Price per Mini bag in Ghana Cedi			Average Price per Maxi bag in Ghana Cedi		
	2011	**2012**	***% change***	**2011**	**2012**	***% change***
Ashanti	06.00	08.00	*33.3*	12.00	13.00	*8.3*
Brong Ahafo	05.00	07.25	*45.0*	10.00	14.00	*40.0*
Central	11.00	16.00	*45.5*	21.00	28.50	*35.7*
Eastern	07.00	13.00	*85.7*	12.00	20.50	*70.8*
Gt. Accra	13.00	14.00	*7.7*	20.00	19.00	*-5.0*
Volta	10.00	12.75	*27.5*	20.00	24.00	*20.0*
Western	10.00	17.00	*70.0*	15.00	26.00	*73.3*
Northern	09.00	07.50	*-16.7*	14.00	15.50	*10.7*
Upper East	05.11	11.00	*115.3*	10.00	15.50	*55.0*
Upper West	05.00	11.00	*120.0*	10.00	17.00	*70.0*

In terms of the weights of the charcoal, [84], Western Region displaced Central Region as the highest-price region in 2012. The third highest was Volta Region (*see Table 27*).

[83] The price survey was conducted in the district capitals and computed as average for each region.

[84] In terms of the charcoal weight:

- Significant quantities of charcoal production in Ashanti and Eastern Regions come from wood off-cut and sawmill residues. The average mini (fertilizer) bag of charcoal weighs from 21-22 kg and the maxi bags weigh from 44-45 kg.
- For most parts of coastal Central Region and for some parts of Greater Accra, particularly, the Ashaiman suburban, there is significant charcoal production from Acacia plantations. The weight range of mini bag acacia-based charcoal is 31-32 kg and for the maxi bag, the range is 57-63 kg.
- For all other regions, particularly, from the Brong Ahafo upwards to the Upper regions, the average mini bag charcoal weighs around 26 kg and the average maxi bag weighs about 52 kg.

Table 27. Average price per kilogramme of bag of charcoal in the regions for 2011 and 2012.

Region	2011			2012			*change in mean price*
	Average Price per kg in Ghana Cedi			Average Price per kg in Ghana Cedi			
	Mini Bag	Maxi Bag	Mean	Mini Bag	Maxi Bag	Mean	*Percentage*
Ashanti	0.27	0.27	0.27	0.32	0.26	0.29	*7.4*
Brong Ahafo	0.19	0.19	0.19	0.24	0.24	0.24	*26.3*
Central	0.35	0.35	0.35	0.54	0.48	0.51	*45.7*
Eastern	0.27	0.23	0.25	0.49	0.40	0.45	*80.0*
Gt. Accra	0.50	0.38	0.44	0.46	0.33	0.40	*-9.1*
Volta	0.38	0.38	0.38	0.51	0.50	0.50	*31.6*
Western	0.38	0.29	0.34	0.66	0.50	0.58	*70.6*
Northern	0.29	0.27	0.28	0.24	0.27	0.26	*-7.1*
Upper East	0.20	0.19	0.19	0.36	0.27	0.32	*68.4*
Upper West	0.19	0.19	0.19	0.34	0.29	0.32	*68.4*

The lowest-price regions were Brong Ahafo, Northern and Ashanti.
There were significant price increases between 2011 and 2012 in Eastern, Western, Upper East and West regions.

We estimate that average charcoal price in 2013 would increase by 20-25% over 2012 average price nationwide due to the nationwide LPG price increment in early 2013. The increment could reach 30-35% on the average in the southern sector should there be significant shortfall in LPG supply across the country during the year.

5.0 The Regulatory environment

5.1 The Electricity supply industry

5.1.1 Licensing and Permitting

The Energy Commission in 2006 established a licensing framework for licensing electricity service providers. The Licensing Manual for service providers in the Electricity Supply Industry was published in 2006, setting the requirements and guidelines for entities desiring to acquire licenses to operate in the electricity supply industry.

Under the Licensing framework, provisional and full licences have been issued to entities engaged in the various segments of electricity supply. Besides adding generating capacity to existing capacity and enhancing service delivery to customers, the licensing regime enhances the Commission's authority to hold the licensees to terms and conditions stipulated in the licence.

Licenses and permits issued by the Commission so far are as follows:

i. Three new Wholesale Electricity Supply Licences were issued to Independent Power Producers (IPP) to construct and operate thermal plants. Out of this, 200 MW from the Sunon Asogli Plant and 126MW from Tema Osonor Power Plant (now Cenit Energy Limited) has been realized since last quarter of 2010. Cenpower Generation Company is preparing to begin construction and when completed will add 300 MW to Ghana's generation capacity.
ii. Volta River Authority (VRA), a Government owned utility, has been issued a Construction Permit to construct a 220 MW Kpone Thermal Power Project in Tema.
iii. Two VRA thermal plants namely TAPCO (T1) and Tema Thermal 1 Power Plant (TT1PP) were issued permanent wholesale supply licences.
iv. The TICO thermal generation plant in Takoradi, which is jointly owned by VRA and TAQA global, was issued permanent wholesale supply licence.
v. One (1) private distribution utility, Enclave Power Company was issued licence to distribute and sell electricity without discrimination to customers in the Tema Free Zone Enclave.
vi. Operations of the Electricity Company of Ghana (ECG), a Government owned utility, was also regularized by issuing them with permanent operational distribution and sale licence.
vii. A Distribution and Sales Licence was issued to the Northern Electricity Distribution Company.
viii. Ten (10) Provisional Wholesale Electricity Supply licences have been issued to potential Independent Power Producers. This are expected to bring on line 3,090 MW of power when plants are constructed

ix. Two (2) applications for Provisional Wholesale Electricity Supply licences are being processed for Independent Power Producer with an expected capacity of 500 MW.
x. Thirty-one (31) Bulk Customers of electricity have been issued permits to enable them operate in the deregulated Wholesale Electricity Market.

In May 2012, the licensing Manual was reviewed to make it simpler and more precise in guiding prospective licence applicant through the licensing process. Also, new licences including Electricity Import, Export and Brokerage licence have been introduced.

5.1.2 Codes of Practice and Regulations

The Commission developed and launched the ***National Electricity Grid Code*** in 2010 to govern the operation of the National Interconnected Transmission System (NITS). The Grid Code specifies in detail the technical operational rules, codes and procedures as well as obligations and liabilities of all players in the market. Complementary to the National Electricity Grid Code, The Energy Commission is has completed the drafting of the ***Electricity Distribution Code***, that sets in detail, the minimum acceptable technical standards for the development of the electricity distribution networks, provides guidelines and technical requirements for interconnection and evacuation of embedded generation and other relevant issues related to the safe and reliable management and operation of the Electricity Distribution Network. The draft is currently undergoing stakeholder review and should be launched by the end of the year.

The Commission is developing a **Toll Free Short Code** service which would allow the general public to report on outages, and poor voltage levels by sending text (SMS) messages. This initiative would provide the Commission with information from both the customers (who experience the outages) and the utilities (who are responsible for maintaining power supply). This would enable the Commission to cross-check the information provided by the utilities with the reports provided by customers, and thereby obtain a much clearer and validated picture of the outage level within the distribution network.

The Commission has developed the Electrical Wiring Regulation 2011, L. I. 2008 to regulate electrical wiring in the country. This is to ensure the safety of persons, property and livestock from the use of electrical energy.

Pursuant to the above, a certification guideline was developed in August 2012. Further, a curriculum for the certification examination was also developed in conjunction with the Technical/Vocational Education Directorate of the Ghana Education Service. All stakeholders have also been met to discuss the implementation of the provisions of the Regulations.

In 2013, the Commission is expected to collaborate with the agencies involved in the certification process and coordinate activities towards the certification of the first batch of Electrical Wiring Practitioners under the developed certification scheme. The Commission would also carry out public sensitization activities to create awareness in the general public on the provisions of the Regulations.

5.1.3 Establishment of Wholesale Electricity Market

The Electricity Regulation 2008 provides for the establishment of a competitive wholesale electricity market to facilitate wholesale electricity trading and the provision of ancillary services in the NITS. The operator of this Wholesale Electricity Market(WEM) in Ghana (the ETU) shall ensure the procurement and dispatch of electricity from any facility of a wholesale supplier to a bulk customer and distribution utility in a fair, transparent and non-discriminatory manner.

The Wholesale Electricity Market would allow for choice and competition in the wholesale supply of electricity and subsequently create an enabling environment to attract Independent Power Producers (IPPs) as well as enhancing Ghana's strive towards increasing its installed capacity from the current 2000MW to 5000MW by 2016.

Further incentive for private sector investment in the Wholesale Supply of electricity is Ghana's interconnection with some neighbouring West African countries, thereby opening up the market for electricity in those countries to IPP's in Ghana.

Such a market, in principle, requires to be guided by rules and regulations (backed by legislation) that should essentially reflect government's broad policy objectives regarding the structure and administrative management and operation of the market.

5.2 The Natural Gas supply industry

Electricity supply is heavily dependent on the availability of fuel to power the thermal plants. So far, natural gas supply from Nigeria through the West African Gas Pipeline (WAGP) has proven unreliable. The development of the gas from the Jubilee field is expected to boost the installation and operation of more gas fired plants to increase Ghana's generation capacity.

The Energy Commission is also leading the coordination of efforts to procure Liquefied Natural Gas (LNG) through a Floating Regasification Storage Unit (FRSU) to ensure adequate supply of gas in the short to medium term as the country awaits the delivery of pipeline gas from the Jubilee Field.

5.2.1 Licensing and Permitting

A Licensing Manual for Natural Gas Supply Industry was developed by the Energy Commission in 2008 to serve as a guide for prospective natural gas service providers with regard to licensing requirements as well as assisting in ensuring compliance with codes and standards governing quality, health and safety in the industry as stipulated in the Energy Commission Act, 1997 (Act 541). The manual is currently under review to facilitate the accelerated development of the natural gas industry.

i. In January 2010 a Construction Permit was issued to BOST to enable them install an interconnection header in the yard of WAPCo's Regulating and Metering Station (RMS).

ii. In 2010, applications for Construction and Siting Permits were received from the Volta River Authority (VRA) and Sunon Asogli Power (Gh) Limited in respect of the individual pipeline connection to its Thermal Power Plant and interconnection header arrangement to the WAPCo Regulating and Metering Station in Tema. Permits were not issued to VRA and Sunon Asogli Power (GH) Limited as expected because they did not provide sufficient evidence that their pipelines have been inspected and certified as safe.

   Provisional wholesale Supply Licence has been to Ghana National Gas Company (GNGC) . Also, a Construction Permit has been issued to GNCC for the construction of pipelines from Atuabo – Aboadze. Siting Clearance has been issued for the gas processing plant, pipelines from Atuabo to link the West African Gas Pipeline at Aboadze, and pipelines from Essiama to Prestea, An application for a Construction Permit for the construction of a gas processing plant at Atuabo is being processed.

iii. A Provisional Gas Transmission Utility Licence has been issued to BOST to operate the Natural Gas Transmission Interconnected System(NGTIS)

5.2.2 Codes of Practice and Regulations

Since the natural gas industry is new in Ghana and like any other energy infrastructure, it is important that before any construction of a facility takes place, the developer must be made to satisfy some basic requirements and comply with established regulations.

It is in this respect that the Energy Commission has since developed the ***Natural Gas Pipeline Safety Regulation*** with adopted Ghana Standards, which is about to be placed before parliament for enactment.

The Commission is also in the process of developing an ***Occupational Health and Safety Regulation*** with adopted Ghana Standards. A ***Transmission Access Code*** to establish conditions for Natural Gas Service Providers to have fair, transparent and safe access to the Natural Gas Transmission Network in Ghana, is also currently being developed in accordance with Sections 24, 27 and 28 of the Energy Commission Act, 1997 (Act 541).

Annex1 – Schematic Overview of Ghana Energy Demand and Supply System

The integrated energy supply feeds the energy-demand economic sectors comprising Residential, Commercial & Services, Agricultural & Fisheries, Transport and Industries. The Energy Supply Sector of Ghana is thus: **Biomass, Petroleum and Power (Electricity),** whilst the Energy Demand sectors of the economy are the **Residential, Commercial & Services, Agricultural & Fisheries, Transport and Industries** (Figure A).

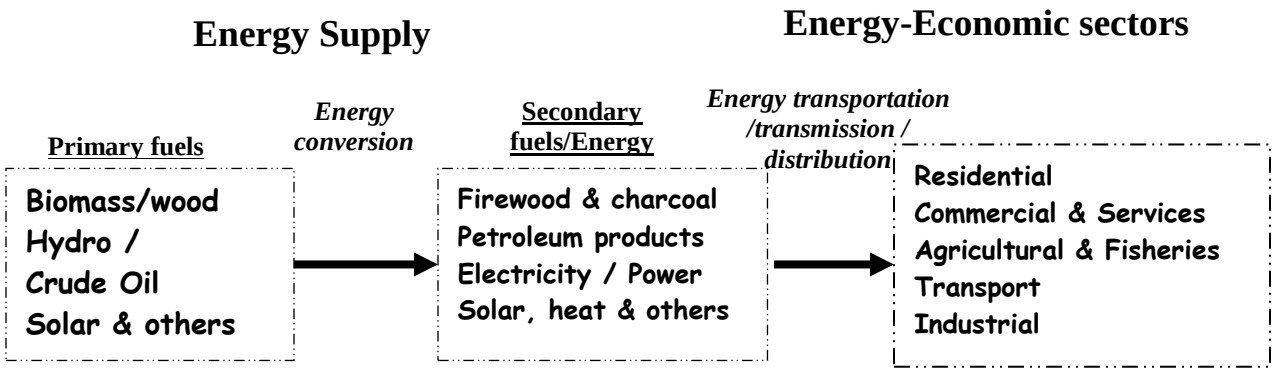

Figure Annex A1. Energy supply continuum

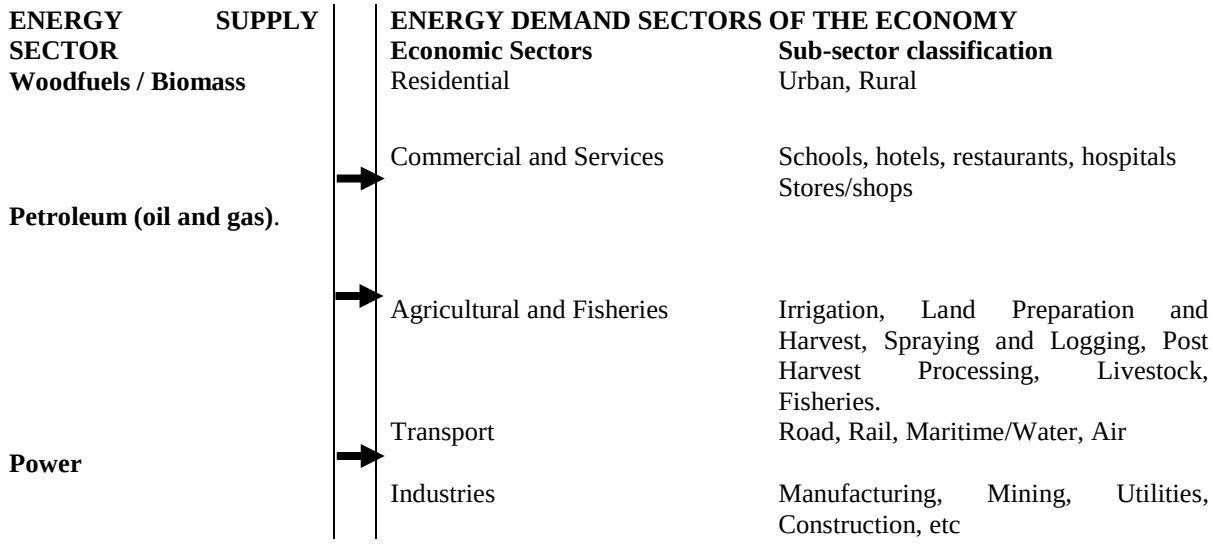

Figure A2. Energy supply continuum

Annex 2 – Existing 100-200 mmscfd LNG plants worldwide

Continent	Country	Capacity Mmscfd	Number Installed	Existing	Status	
					Announced/ Proposed	Approved/ under construct
Asia	China	200	0	0	1	0
	India	200	0	0	1	0
		100	1	1	0	0
	Indonesia	200	0	0	1	0
	Japan	100	3	3	0	1
		200	2	1	2	0
	New Zealand	200	0	0	1	0
	Philippines	200	0	0	2	0
	Sri Lanka	100	0	0	1	0
	South Korea	200	1	1	0	0
	Taiwan	200	1	1	0	0
Europe	Belgium	100	3	3		1
	Cyprus	100	0	0	1	0
	France	100	2	2	1	0
	Greece	200	1	1	0	0
	Italy	200	1	0	2	0
	Lithuania	200	1	0	1	0
	Poland	200	0	0	1	0
	Spain	100	5	5	1	1
		200	7	7	0	0
	Netherlands	100	1	0	1	1
		200	1	0	0	1
	U.K	100	1	1	1	0
		200	5	5	2	2
North America	Dominican Rep	200	0	0	0	1
	El Salvador	100	0	0	0	1
	Puerto Rico	100	1	1	1	0
	United States	200	3	3	0	0
South America	Brazil	200	1	1	0	
	Chile	200	0	0	0	2
		100	2	2	0	0
Africa	South Africa	200	0	0	1	0
Global Total			**43**	**43**	**22**	**11**