

Full Length Research Paper

Ghana's downstream petroleum sector: An assessment of key supply chain challenges and prospects for growth

¹Richard Amponsah (Dr.) and ²Francis Kelvin Opei

¹Gimpa, P.O. Box ah 50, Achimota, Accra.

²Misyl Energy Company Limited, No. 49 Mensah Wood Street, East Legon Accra, Pmb 37 Legon, Accra.

Accepted 13, June 2014

Ghana's petroleum industry, though relatively young has been touted as having the potential to moving the country from a developing country to a developed one. The growth of the industry is highly dependent on ensuring that petroleum products produced at the downstream sector of the industry are distributed consistently and timely to consumers through an effective and efficient supply chain system. Though this is the ideal situation yearned for by stakeholders, the sector is plagued with challenges that negatively impacts on performance. This study, therefore explored supply chain challenges in the downstream petroleum sector in Ghana. A mixed method approach was adopted to study the phenomenon. Data was collected from key players in the downstream petroleum sector through in-depth interviews and a questionnaire. The study discovered government interference in activities of actors, inability of government to pay under recoveries, government indebtedness to actors, inadequate infrastructure and inability of TOR to refining crude regularly as key challenges that impacted on an effective and efficient supply chain process. The study recommended, the Government of Ghana to inject capital for infrastructural development of the sector as well as wean off its interference in the activities of actors. In this case, key national players like BOST should be given autonomous status.

Key words: Assessment, downstream petroleum, supply chain, challenges and prospects, Ghana.

INTRODUCTION

The oil and gas industry is one of the largest and most complex industries in the world today that touches on peoples' everyday lives with services ranging from transportation, electricity, heating, lubricants and a host of chemical and petrochemical products. Globally, a whopping 30 billion barrels of oil is consumed per year. The United States Energy Information Administration (EIA) in its 2011 International Energy Outlook projects that the world's energy consumption will increase by 53% by the 2035 (Gruenspecht, 2011). In Europe and Asia, oil accounts for 32% of energy consumption, whilst in the Middle East, 53%. For South and Central America the figure is 44% whereas in North America it is 40%.

The total energy consumption in Africa is 41% of (Petroleum Industry, Wikipedia, 2013).

In Ghana, petroleum products account for about 26% of total energy consumption (Ministry of Energy, 2010) and about 70% of Ghana's commercial energy needs (Oil and Gas in Ghana - Overview, 2013). The Ministry of Energy estimates that the market for major petroleum products in Ghana will grow by 5.3% annually through 2015 and projects this figure is likely to increase if economic growth is sustained.

The petroleum industry includes the global processes of exploration, extracting, refining, transporting and marketing petroleum products. The industry is usually divided into three major sectors: upstream, midstream and downstream (Petroleum Industry, Wikipedia, 2013). The upstream is concerned with exploration and production, the midstream deals with storage, marketing and transportation of commodities like crude oil, natural

*Corresponding author. E-mail: Rakadoo669@yahoo.com
Tel: 233208412896

gas, natural gas liquids (NGLs, mainly ethane, propane and butane) and sulphur. The downstream sector involves oil refineries, petrochemical plants, petroleum products distributors, retail outlets and natural gas distribution companies. Midstream operations are considered a part of the downstream sector. In Ghana, the upstream sector is regulated by the Ghana National Petroleum Corporation (GNPC), whilst the downstream sector, the National Petroleum Authority (NPA). The discovery of oil in commercial quantities in 2007 raised the expectations of stakeholders and consumers alike of the petroleum sector on its significant role and contribution to Ghana's developmental efforts in accelerated economic growth, job creation, poverty reduction and general prosperity to the people of Ghana (National Energy Policy, 2010).

Despite these expectations, energy supply in Ghana continues to be a bottleneck with countless instances of perennial petroleum product shortages. Reasons advanced for these shortages range from the delay of vessels supposed to discharge refined products and the inability of Oil Marketing Companies (OMCs) to obtain letters of credit from banks. Similarly, the shortages were blamed on limited nation-wide storage capacity and the inadequate revenues generated from sales of LPG due to cross-subsidization (Energy Outlook for Ghana, 2013).

Government's policy goal as outlined in the National Energy Policy document is to facilitate the universal access to adequate, reliable and cost effective petroleum products such as Liquefied Petroleum Gas (LPG). In 2005, Parliament passed the NPA Act 691 which mandated the National Petroleum Authority (NPA) to regulate, oversee and monitor activities in the petroleum downstream industry (National Petroleum Authority Act, 2005). The Act also established a Unified Petroleum Pricing Fund (UPPF) whose objectives include guaranteeing regular supply of petroleum nationwide, ensuring that prices of petroleum products include an element that represents estimated cost of distribution and achieving an efficient petroleum products distribution system. Despite these policy guidelines and efforts, the downstream petroleum sector, which is expected to play a pivotal role in Ghana's petroleum sector is saddled with numerous problems and challenges which needs to be addressed if constant supply of petroleum products is to be reliable and sustained. The objectives of the paper, therefore are to:

- Examine key supply chain challenges in the downstream petroleum sector and how they affect the supply of petroleum products
- Explore prospects for future growth of the sector
- Assess the role of NPA in ensuring supply chain efficiency in the sector.

It worth mentioning that study is limited to challenges and practices that impact the effective and efficient operation

of activities on the mainstream petroleum sector, from when crude oil or petroleum products arrive in the country until it reached the final consumer. Thus, activities or practices pertaining to the upstream sub-sector were not considered.

LITERATURE REVIEW

Oil and Gas Exploration in Ghana

Hydrocarbon exploration in Ghana started as early as 1896 as a result of oil seeps found in the onshore Tano Basin in the Western Region of Ghana. (Tullow Oil Ghana, 2013). After that further exploration activities were undertaken between 1909 and 1913, 1923 and 1925, 1956 and 1957 (Ampofo, 2008).

The first offshore commercial hydrocarbon production in the Salt pond Basin however started in 1975. Ghana's first petroleum law, Ghana National Petroleum Corporation (GNPC) Law, 1983, (PNDCL 64) was passed in 1983 which provided new statutory and legal framework which would accelerate exploration and production efforts (Ghana Exploration and Production Forum, 2013). Between 1989 and 1990, Ghana's only oil refinery at Tema underwent some major rehabilitation with the aim of improving distribution of liquefied petroleum and increasing the quantity supplied to all parts of the country. National distribution was however not uniform irrespective of the measures adopted. Other measures to improve the situation included a project to set up a national network of storage depots in all regions.

Downstream Petroleum Industry

Literature relating to supply chain especially in the downstream petroleum is scanty. However, with a realisation of effective supply chain management, the trend is increasingly changing. According to Lewin (2003), the importance of the sector in fulfilling the majority of transportation needs, providing power and serving as a foundation for petrochemical business underpins the survival of other essential industries (Lewin, 2003).

The goal of supply chain is to provide maximum customer service and satisfaction at the lowest cost possible. Currently, more opportunities exist for coordinating supply chain activities across oil and gas operations due to improved information and communication systems and technologies (Chima, 2007). According to Balasubramanian (2010), the downstream oil distribution is increasingly adopting a variety of supply chain solutions ranging from crude selection to product distribution at the retail outlet in the face of uncertainties relating such as oil prices, refining margins and long lead

times associated with crude purchasing and product trading.

Key Players in Ghana's Downstream Petroleum Sector

Ministry of Energy and Petroleum

The Ministry of Energy and Petroleum plays a supervisory role of the sector. Its core duties are policy formulation, planning, monitoring and evaluating energy sector policies. The vision of the Ministry is to ensure secure and sustainable supply of energy for Ghana and beyond. Its goal is to make energy services universally accessible and readily available in an environmentally sustainable manner (Ministry of Energy and Petroleum, 2013).

Ghana National Petroleum Corporation (GNPC)

GNPC is the industry regulator for the Upstream Petroleum Sector of Ghana. The vision of the corporation is to become a world-class corporation capable of making Ghana the fastest growing destination for upstream petroleum investments in West Africa (GNPC, 2011). Established in 1983 as a State-owned entity, the corporation derives its legal backing from PNDC Laws 64 and 84. PNDC Law 64 mandates the GNPC to undertake the exploration, development and production of crude oil.

National Petroleum Authority (NPA)

The NPA was established in 2005 by NPA Act 691 which mandated it to regulate, oversee and monitor activities in the petroleum downstream industry and where applicable do so in pursuance of the prescribed petroleum pricing formula. (National Petroleum Authority, 2013). The Act also established a Unified Petroleum Pricing Fund (UPPF) whose objectives include guaranteeing regular supply of petroleum nationwide, ensuring that prices of petroleum products include an element that represents estimated cost of distribution and achieving an efficient petroleum products distribution system.

Tema Oil Refinery

Tema Oil Refinery (TOR) Limited the only refinery in Ghana is authorized to process crude oil and market petroleum products. Until recently, Ghana imported all of her crude oil requirements through a crude oil allocation contract which is renewable annually. Ghana's annual consumption of refined petroleum products is about 1.8 million. With increasing demand, shortfalls are covered with imports of refined products by the Bulk Oil Storage and Transportation (BOST) Company Limited and Oil

Marketing Companies (OMCs) (Tema Oil Refinery, 2011). The NPA has also licensed various Petroleum Service Providers to import crude and petroleum products, export, distribute and market them. These include Bulk Distribution Companies (BDC), Oil Trading Companies (OTC) and OMCs.

Bulk Oil Storage and Transportation Company Limited (BOST).

The Bulk Oil Storage and Transportation Company Ltd (BOST) was incorporated in 1993 as a private Limited Liability Company with the Government of Ghana as the sole shareholder.

BOST has the mandate to develop a network of storage tanks, pipelines and other bulk transportation infrastructure throughout the country and to keep Strategic Reserve Stocks for Ghana.

BOST has been given an additional mandate as the Natural Gas Transmission Utility (NGTU) to develop the Natural Gas infrastructure throughout the country. Its vision is to be the preferred provider of oil and gas logistics in the West African sub-region.

Bulk Distribution Companies (BDCs) and Oil Trading Companies (OTCs)

These companies have been licensed by the National Petroleum Authority (NPA) as bulk distributors. They also import crude oil, procure, store, distribute and sell petroleum products particularly to Bulk consumers. These entities also served as petroleum product suppliers in times of crisis. Additionally, the BDCs supply their products to Oil Marketing Companies who retail nationwide. The major BDCs in Ghana are Fuel trade, Cirrus, Chase, ECO, Vihama, Springfield, Ebony, Oil channel, Dominion, Alfa Petrol, Peace, Blue Ocean, TOR, PWSL, Hask and First deep water (Peacefm Online, 2013)

Oil Marketing Companies (OMC)

These procure and sell refined petroleum products to bulk consumers and the general public through retail outlets like fuel stations and other reselling outlets. They also supply petroleum products in times of crises with the consent of the National Petroleum Authority.

METHODOLOGICAL APPROACH

The research adopted a mixed method approach in gaining a much deeper understanding of Ghana's downstream petroleum sector. Thus, both qualitative and

quantitative methods of data collection and analysis were used. This was due to the exploratory nature of the study. Data collection tools included an interview guide and semi-structured questionnaire which were administered personally. The questionnaire and interview were structured in a way to facilitate a complete map and overview of the supply chain, demand and supply dynamics, product forecasting, product inventory and safety stock management and associated challenges in Ghana. In addition to the methods identified, there was a comprehensive review of literature on the sector to facilitate a deeper understanding of the global petroleum industry and Ghana's downstream petroleum sector in particular. Information gleaned from the literature was used to support extensive interview data from key stakeholders/actors in the sector. Key personnel from the National Petroleum Authority, Bulk Oil Distribution and Storage Company, (BOST) and Bulk Oil Distribution Companies (BDCs), Oil Marketing Companies (OMCs) were purposively selected.

The story of the sector was told with extensive trend analysis and data visualizations. The qualitative data obtained from the interviews allowed for comparison of strategies among the different actors. It also served as basis to understand how these strategies individually and collectively would help to sustain the supply chain and help assess the extent of its preparedness to recover from perceived disruptions. The qualitative analyses were buttressed with extensive quantitative data analyses using the best Business Intelligence, data analysis and visualization tool in the world currently as assessed by Gartner, the world's leading information technology research and advisory company (http://www.gartner.com/technology/why_gartner.jsp).

RESULTS AND DISCUSSIONS

Ghana's Downstream and Product Supply Chain

An analysis of data collected brought to light key activities of the downstream petroleum sector in Ghana as depicted in Figure 1.

Imported crude products are stored and refined at the Tema Oil Refinery. Imported refined products together with refined products from the refinery are shipped mainly via pipelines to storage facilities. From these facilities, the products are distributed to the various markets (industrial and retail). Within the supply chain are various players whose actions or inactions impact the efficiency, agility and sustainability of chain.

Challenges and Supply Chain Actors

Data collected from various actor within the downstream sector brought to the fore key supply challenges that

impacted on the effectiveness and efficiency of operational activities. These challenges identified ultimately affected the overall national goal by the government of Ghana in ensuring timely and consistent supply of petroleum products to consumers. These challenges are tabulated (See Table 1) and described with specific reference to key actors.

The Bulk Road Vehicle (BRV) Tracking System

Frequent cases of product thefts, compromised quality and the lack of visibility in the operations of BRVs led the NPA to commission this tracking system. Specifically, since the tracking system became operational, the following benefits have been gained:

- Ability to confirm OMC claims
- Discouraged submissions of false returns
- Reduced product distribution malfeasance
- Total visibility on BRVs and the quantity of products in them
- Avoidance of zonal violations of BRVs
- Ability to identify actual location of outlets
- Ability to determine actual volumes discharged at retail outlets

Deregulation

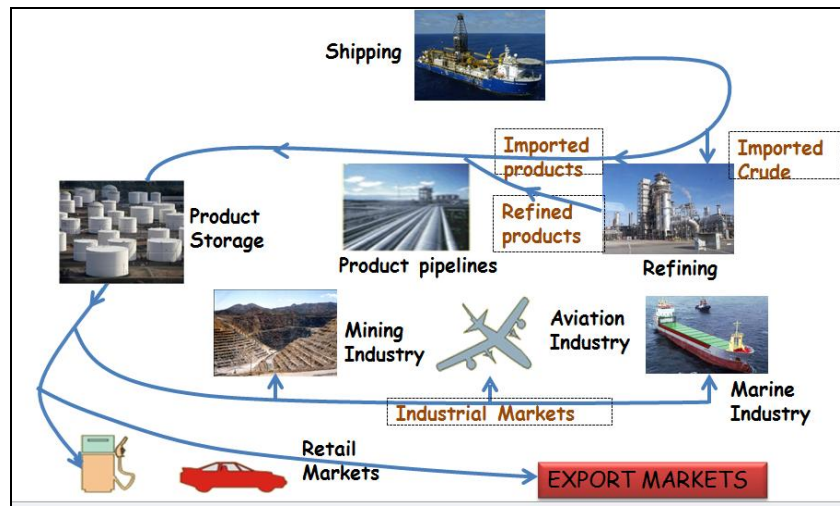
Deregulation means the removal of government controls from an industry or sector, to allow for a free and efficient market place. This includes allowing the forces of demand and supply to determine ex-pump prices of petroleum products as well as to set operating margins and tariffs in the industry. It will also mean ensuring there are no barriers to entry, no cartelization, etc. It means generally, driving the petroleum downstream market toward perfect competition amongst the players.

The deregulation process in Ghana can be said to have been a cautioned success, with all the targets largely met except the price decontrol target. It has been modified, to ensure that there is full cost recovery to all investors in the downstream, while taking into consideration the quality of petroleum products. Government control on importation of crude oil and petroleum products, as well as its control in the establishment and operation of facilities, has been reduced to a laid back regulatory role, present only to ensure sanity and allow market forces to work.

SUMMARY OF FINDINGS

The study unearthed key product distribution challenges in the supply chain process of the downstream petroleum sector in Ghana such as poor infrastructure, theft and the difficulties in transferring products from one

Figure 1. Ghana's Downstream Crude and Products Supply Chain.



Source: Field Work (2014).

Table 1. Summary of Key Challenges Identified by Actors.

Actor/Stakeholder	Mandate	Key Challenge(s)	Strategy
Oil Marketing Companies (OMCs)	Licensed to procure petroleum products from TOR/BDCs for sale to bulk consumers and the general public through petroleum retail stations and outlets.	<ul style="list-style-type: none"> Poor forecasting Inability of TOR to refine regularly Frequent delays by Government in reimbursing BDCs for under recoveries Lack of storage facilities 	<ul style="list-style-type: none"> Allowing market forces to determine product prices through deregulation Making BDCs more solvent whilst enforcing laws on non-performance
Bulk Distribution Companies (BDCs)	<ul style="list-style-type: none"> Licensed to import crude oil as well as procure, import, store, distribute, and sell petroleum products on wholesale to bulk customers including Oil Marketing Companies (OMCs). Perform monthly volume forecast based on customer demand 	<ul style="list-style-type: none"> Government's non-payment of under recoveries resulting in locked up capital. Weak local currency/frequent exchange rate losses to BDCs. Delayed payment by customers Lack of customer loyalty 	<ul style="list-style-type: none"> Timely repayment of NPA subsidies and under recoveries to facilitate investment in infrastructure importation products in a timely manner. Better management of the BOST systems.
Bulk Oil Storage and Transportation (BOST)	<ul style="list-style-type: none"> Mandated to develop a network of storage tanks, pipelines and other bulk transportation infrastructure throughout the country Keeping strategic reserve stocks for the country. 	<ul style="list-style-type: none"> Government's indebtedness to BOST and frequent interference. Lack of funds and poor infrastructure renderings policy dormant. Differences in government's policy on primary distribution margin and BOST margins levels that does not allow the company to embark on infrastructure expansion to satisfy the escalating demand and enhance effective movement of products between depots. 	

depot to the other as well as some reasons accounting for real and artificial product shortages such as the

inability of TOR to refine products according to expectations, the difficult of players to import products

Table 1. Summary of Key Challenges per Actors (Contd.).

Actor/Stakeholder	Mandate	Key Challenge(s)	Strategy
National Petroleum Authority (NPA)	<ul style="list-style-type: none"> Regulate the Downstream Petroleum sector Ensure fair competition in the industry. Periodic review of Petroleum product Prices to reflect private sector environment. License and register downstream sector Operators. Review and set margins to comparable levels within West Africa. Develop database of price, supply, demand, and inventory of products 	Inadequate Infrastructure and Security and integrity of product supply	<ul style="list-style-type: none"> Installation of Bulk Road Vehicle (BRV) tracking system to ensure integrity and accuracy of product distribution countrywide Fuel marking programme to ensure integrity and purity of petroleum products Raising the standard for BDCs, OMCs and Retail outlets Improving petroleum products specifications Fair implementation of cost recovery for investors – OTCs, BDCs, OMCs and Retail Outlet Operators Promotion of private sector infrastructure Deregulation.

Source: Field Work, 2014

and embark on infrastructure expansion due to delays by Government in paying under recoveries.

It was also discovered that though consumption patterns for both Gas and Premium continued to increase since 2010, yet the trends for the other petroleum products are almost flat. This is a worrying trend that requires the attention of players in the sector in product ordering and stocking decisions of players although ex-refinery product prices experienced some marked deviations at the beginning of the year but remains flat for the rest of the year even though the variance is almost insignificant.

The sharp currency fluctuations pose problems for importers coupled with delayed payment by Government for under recoveries. The implications are that product flows will be hampered, real and artificial shortages will be expected. As the currency remains unstable and product supply unpredictable, retail outlets might want to hold on to their available stock in hopes of cashing in on any windfall. Demand forecasting will also remain difficult as in such circumstances it is not easy to estimate accurately the real demand.

CONCLUSION

Compared with other markets, Ghana's downstream petroleum supply chain could be said to be in its formative years even though the industry has been around for quite a sometime. Industry players face many challenges ranging from very poor infrastructure, to lack of requisite capital and a weak a local currency resulting

in foreign exchange losses. Governments delayed payment of under-recoveries and very low margins for players makes the prospects in ensuring constant product availability a serious challenge. Government's interference with the sector has also been criticized for not allowing market forces to shape demand and supply. TOR's inability to live up to expectations in product refinery continues to dent a big blow in the downstream petroleum supply chain. Distribution inefficiencies, pilfering, vandalized pipelines and poor maintenance culture worked closely to offset product availability and integrity. In such a volatile market, it is expected that safety and strategic stocks would be accorded the much needed attention. An average safety stock of 6 weeks is often spoken of but in reality not the case. There are also currently no strategic stocks that the country could fall back on in case of global disruptions.

The findings pointed to the fact that product consumption continues to increase with increase in population yet the supply does not correspond to demand. Most of these players forecast individually which is quite inimical to the growth of the sector. In cases where some measure of collaboration fostered, lack of funds and delayed payment by Government militates against the procurement of forecasted quantities for supply.

RECOMMENDATIONS

The NPA's deregulation drive is helping create opportunities for more private sector participation, hence

injection of the needed capital for infrastructural expansion. To a large extent, market forces are being allowed to dictate dynamics of supply and demand although much still needs to be done. Again NPAs drive in the installation and commissioning of BRVs Tracking System has chalked considerable success in creating greater visibility in product distribution and integrity. The benefits of these laudable measures continue to alert stakeholders of the need to improve their operational activities. From a purely economic point of view, Government ought to continue to ease its influence to allow for market forces to dictate local market trends. Key organizations like BOST should be placed in a position where it could be more self-sustaining, autonomous and capable of generating funds for infrastructural developments. There have been justifiable calls for TOR to step-up its game in the refinery business and this will require huge capital injections. Nevertheless, the growing demand justifies such an investment for the sustainability of the downstream petroleum supply chain.

POLICY IMPLICATIONS

With only about 60% of the national petroleum product requirement being met from domestic production at the Tema Oil Refinery (TOR), and the remaining 40% from importation, there will be the for Ghana to build adequate capacity to enable it become not only self-sufficient in the production of petroleum products but also the "Petroleum Hub" of the West African Sub-region. Access to petroleum products in the rural areas is inadequate due to limited infrastructure for storage and equipment for distribution and use. The medium term strategic objective of government should be to increase access to petroleum products particularly in rural areas.

The deregulation of the petroleum sector aims at removing the inefficiencies in the sector by allowing private sector participation in the procurement of oil and gas, which has previously been limited to the TOR. Under this deregulated regime, the private sector is now allowed to import finished petroleum products (about a third of total oil demand) into Ghana through open and competitive bidding.

The opening up of imports of refined petroleum products by private enterprises is a right step towards eventual full liberalization of the sector. The private sector should be encouraged to participate fully in the importation of crude oil for processing by TOR for sale to the local market and for export. Ghana should implement a framework in which the Oil Marketing Companies (OMCs) and other distributors to retail prices for petroleum products according to a pricing formula and without prior review or approval by any other authority. The pricing system should be set to ensure that all costs and applicable taxes are fully recovered.

REFERENCES

- Association of Oil Marketing Companies (2013). Retrieved from <http://aomcs.org>
- Chima CM (2007). Supply Chain Management Issues in the Oil and Gas Industry. *J. Bus. Econ. Res.*, 27-36.
- Devold H (2013). *Oil and Gas Production Handbook*. Oslo: ABB Oil and Gas.
- Ghana Exploration and Production Forum* (2013). Retrieved from <http://gh-epf.org/index.php/about-the-industry>
- GNPC. (2011). Retrieved from Energy World/ Africa: <http://www.energyworldafrica.com/pdf/Ghana%20National%20Petroleum%20Corporation.pdf>
- Grant K, Ownby D, Peterson SR (2006). Understanding Today's Crude Oil and Product Markets. API.
- Inkpen A (2010). *The Global Oil and Gas Industry - 2010*. Glendale, Arizona: Thunderbird School of Global Management.
- Lewin G (2003). Managing the Downstream Oil Supply Chain: A Customer-led Strategy. *World Energy*, 22-25.
- Ministry of Energy, G (2010). *National Energy Policy*. Accra.
- Tema Oil Refinery (2011). Retrieved from Energy World Africa: <http://www.energyworldafrica.com/pdf/Tema%20Oil%20Refinery.pdf>
- Ghana Petroleum Exploration* (1994, November). Retrieved from Photius: http://www.photius.com/countries/ghana/economy/ghana_economy_petroleum_exploratio~113.html
- National Petroleum Authority Act* (2005, August). Retrieved from Parliament of Ghana: <http://www.parliament.gh/assets/file/Acts/ACT%20691%20National%20Petroleum%20Authority.pdf>
- Ampofo K (2008, August 25). *GhanaWeb*. Retrieved from <http://ghanaweb.com/mobile/wap.small/news.article.php?ID=149014>
- Balasubramanian K (2010, August 12). Retrieved from Infosys: <http://www.infosys.com/supply-chain/white-papers/Documents/SCM-oil-downstream-distribution.pdf>
- GNA. (2011, May 9). Retrieved from GhanaWeb: <http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=208228>
- Dickson OB (2011, June 16). *A Concise History of Oil and Gas Exploration in Ghana*. Retrieved from uPublish: <http://www.upublish.info/Article/A-CONCISE-HISTORY-OF-OIL-AND-GAS-EXPLORATION-IN-GHANA/552309>
- Gruenspecht H (2011, August). *International Energy Outlook*. Retrieved from U.S. Energy Information Administration: http://www.eia.gov/pressroom/presentations/howard_09192011.pdf

- Daily Graphic* (2013, May). Retrieved from <http://graphic.com.gh/General-News/npa-calls-for-removal-of-petroleum-subsidies.html>
- British Petroleum (2013, June). BP Statistical Review of World Energy 2013. *BP Statistical Review of World Energy*. BP.
- (2013, August). Retrieved from National Petroleum Authority: http://www.npa.gov.gh/npa_new/faqs.php
- Oil and Gas in Ghana-Overview* (2013, August). Retrieved from Mbendi: <http://www.mbendi.com/indy/oilg/af/gh/p0005.htm>
- Petroleum Industry, Wikipedia*. (2013, August). Retrieved from Wikipedia: http://en.wikipedia.org/wiki/Petroleum_industry
- Tullow Oil Ghana. (2013, October). *Tullow Oil Ghana*. Retrieved from <http://www.tulloil.com/ghana/index.asp?pageid=27>
- Bulk Oil Storage and Transportation (2013, November). Retrieved from http://www.bost.com.gh/?page_id=115
- GhanaWeb*. (2013, November). Retrieved from <http://www.ghanaweb.com/GhanaHomePage/NewsArchive/photo.day.php?ID=166029>
- Ministry of Energy and Petroleum (2013, November). Retrieved from <http://www.energymin.gov.gh/>
- Peacefm Online (2013). *Peacefm Online*. Retrieved November 2013, from <http://datablog.peacefmonline.com/pages/blog/10/>
- Shell Refining Company (2013). Retrieved November 2013, from Shell Refining Website: <http://www.shell.com/src/about-src/refining-process.html>