



GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 4: 1st April 2016 to 30th April 2016

This Bulletin covers major developments in the Ghana Wholesale Electricity Market (WEM) from 1st April 2016 to 30th April 2016. It analyses the performance of the key WEM indicators against their benchmarks, and examines the likely implications of any discernable trends for the future of the market. The Energy Commission (EC) would very much appreciate and welcome comments from readers on the Bulletin. Reasonable care has been taken to ensure that the information contained in this Bulletin is accurate at the time of publication, but nevertheless, regrets any errors, omissions or inaccuracies therein.

HIGHLIGHTS OF THE MONTH

Electricity demand grows but still lower than projected for April 2016

Electricity peak load grew by 11 MW between March 2016 and April 2016 while consumption/energy dropped by 36.0 GWh representing about 3% reduction. The Electricity Supply Plan (ESP) developed for 2016 had projected electricity supply of 1,399 GWh for the month of April 2016 with a projected system peak load of 2,362 MW consisting of domestic demand of 2,200MW and export of 152 MW. The outturn of electricity consumption in April 2016 was however 19.2% lower than forecasted. In April 2016, electricity supplied by the power plants was 1,127.7 GWh compared to the projected supply of 1,399.0 GWh as contained in the 2016 Supply Plan. Generation in April 2016 was however higher than in January 2016 (1,093.7 GWh) by 3.01%, about the same in February 2016 (1,126.7 GWh) and about 3.25% lower than in March 2016 (1,164.3 GWh).

The Ghana peak load of 2,019 MW recorded in April 2016 was lower than forecasted but higher than the 1,979 MW, 1,975.4 MW and 2,008.3 MW recorded in January 2016, February 2016 and March 2016 respectively. While it may be considered as marginal growth, the increase in the peak load of 11 MW still raises some concerns given that actual consumption reduced in contrast to the increasing peak load. This is a paradox which may certainly be due to the impact of tariff increases. It also points to the need to ensure the availability of more generating resources. Table 1 shows a comparison of the projected and actual electricity demand and supply for April 2016.

Table 1 Projected and Actual Outturn of electricity supply and demand in April 2016

	April 2016	
	Projected	Actual Outturn
Total Demand (GWh)	1,399.00	1,127.70
Supply by Power Plant (GWh)		
Akosombo	269.0	397.7
Kpong	51.0	77.5
Bui	69.0	165.3
TAPCO	103.0	49.0
TICO	196.0	160.5
Sunon Asogli - Phase I	54.0	44.5
Sunon Asogli - Phase II	110.0	-
CENIT	66.0	66.5
TT1PP	64.0	-
TT2PP	-	7.3
MRP	-	-
KTPP	122.0	9.6
Ameri Energy	149.0	-
Karpowership	146.0	149.9
Trojan	-	-
Import	-	-
Total Supply	1,399.0	1,127.7
Deficit/Over supply	-	271.3
% Reduction in Supply	-	19.39%
Peak Load (MW)	2,200.0	2,019.1

Akosombo and Bui continued to be stressed in April 2016

Owing to the shut down of the Atuabo Gas Processing Plant and the continued difficulties with natural gas supplies from Nigeria, the over-drafting of the Akosombo dam continued in order to make up for the unavailability of the thermal generating units to meet the system demand. Akosombo power station's contribution to peak demand in April 2016 was 753 MW (corresponding to 6 units) up from 507 MW, 521 MW and 742 MW in January 2016, February 2016 and March 2016 respectively. Peak generation from the Akosombo power plant in the month was more than the 375MW (three turbine operation) which was projected for 2016. The Bui Generating Station also generated beyond what was planned for the period. The level of the Akosombo dam continued to drop further below the 240 feet minimum design operating level reaching 237.6 feet at the end of April 2016 from 238.88 feet recorded at the end of March 2016.

Production of electricity from Karpowership power plant increased in April 2016

The availability of the Karpowership power plant has provided significant support to the power system in the face of unavailability of the gas-based thermal power plants. The availability of the Karpowership which runs on Heavy Fuel Oil (HFO) is a strong testimony to the policy of fuel diversity in the planning, development and operation of any power system. Indeed, at the average Heavy Fuel Oil (HFO) price of US\$174.85 per metric ton for the month of April 2016, the Karpowership power plant generated the cheapest electricity, in terms of fuel costs, among the existing thermal power plants.

Ameri Energy Power Plant shutdown in April 2016

The 250MW capacity Ameri Power Plant which began full commercial production of electricity in February 2016 was shutdown throughout the month of April 2016 because of curtailment of natural gas supply from the Atuabo Gas Processing Plant. The curtailment from the Atuabo Gas Processing Plant was as a result of the shutdown of the Floating Production Storage and Off-loading (FPSO) facility. The Ameri Energy Power Plant, since coming on line in February 2016, has contributed significantly to electricity generated from the Aboadze Power Enclave and actually eased the very difficult situation the power sector would have faced without it. The power plant generated 127.1 GWh when it was fully operational for the whole month of February 2016 and 90.86 GWh for a large part of March 2016 until the FPSO was shutdown on 20th March 2016. Electricity generated by the Ameri Energy Power Plant contributed 31.1% and 27.4% of total electricity generated in the Aboadze Power Enclave in February 2016 and March 2016 respectively even though it was shutdown for 11 days in March 2016 owing to curtailment of natural gas supply.

KTPP starts commissioning in April 2016

The Volta River Authority (VRA) commenced the commissioning of the first unit (110 MW) of the Kpone Thermal Power Plant (KTPP) on 20th April 2016. The power plant comprises of two gas turbine units each of 110 MW generating capacity and can be operated on Distillate Fuel Oil (DFO) or natural gas which is the preferred fuel. Even though the power plant was ready for commissioning since

December 2015, it was not done because of the unavailability of natural gas owing to the difficulties in gas supplies from Nigeria. The power plant has had to be commissioned on DFO.

The power plant, when completed will be a combined cycle power plant of 330 MW generating capacity. Construction of the project started in 2007 but was discontinued in 2010 owing to litigation. Construction was continued in 2012 with one (1) of the two (2) gas turbine units being completed in July 2015. Hot commissioning of the power plant was commenced in December 2015 but suspended due to inadequate supply of natural gas. Commissioning continued in January 2016 on Distillate Fuel Oil (DFO) but was also suspended due to inadequate supply of DFO. In April 2016, commissioning of the power plant was resumed on DFO with the power plant generating 10.4 GWh into the power system.

Sunon Asogli Power Plant Phase II achieve commercial operation in April 2016

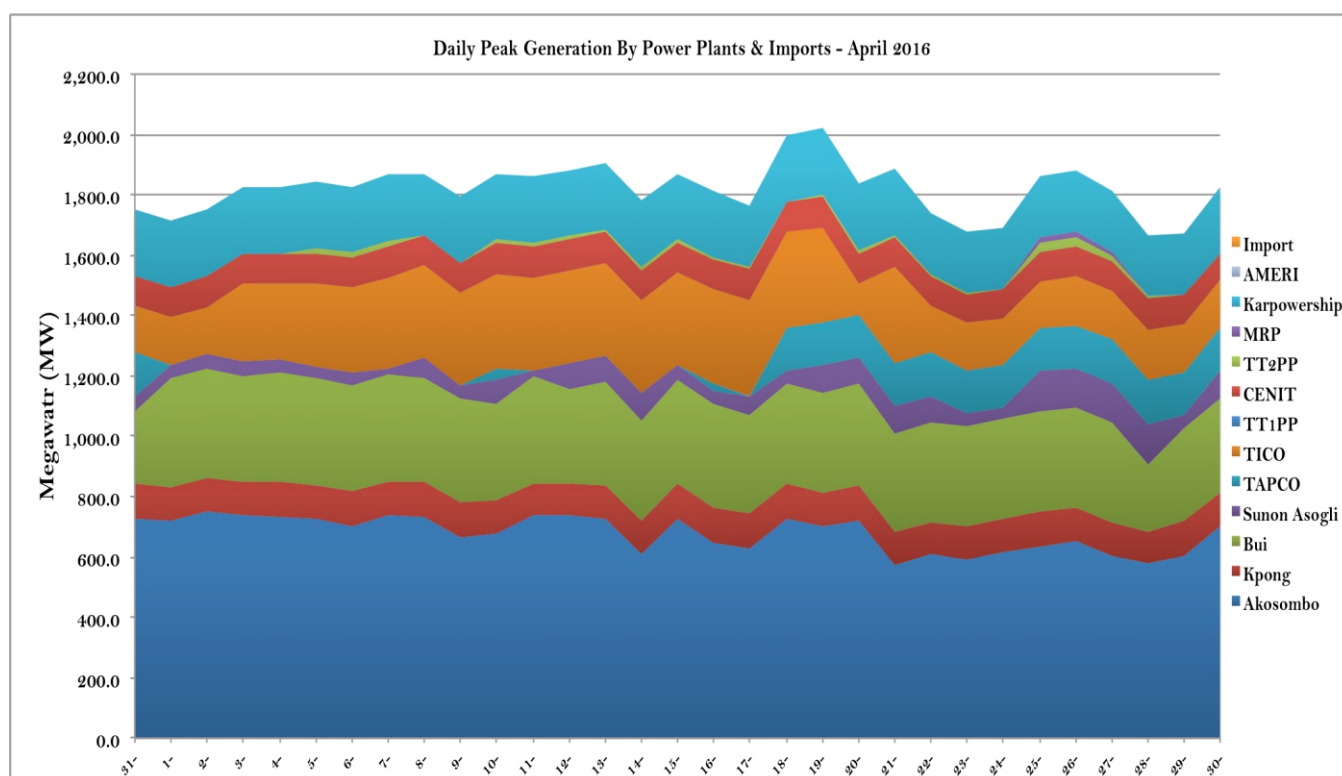
Sunon Asogli Power Complex, located in Tema, is owned by an affiliate of Sheghen Energy Group of China. The Power Complex is intended to accommodate a total of 560 MW capacity power plants when completed. Indeed, the Phase I of the Power Complex comprising a 180 MW combined cycle power plant was the first fully private sector owned power plant in Ghana. The phase II comprise of two blocks of 180 MW capacity combined cycle power plants with a combined total generating capacity of 360 MW. The first of the two combined cycles units (180 MW) of the phase II was put into commercial operation on 11th April 2016. The sod-cutting to signify the commencement of commercial operations of the power plant was performed by His Excellency, the President of the Republic of Ghana. The plant was commissioned on natural gas but it is capable of also being operated on LCO. The power plant generated 0.85 GWh in the month of April 2016.

Spot Market Price of electricity dips in April 2016

The Spot Market Price (SMP) of electricity in the proposed Wholesale Electricity Market (WEM) dropped from US cents 132.98/kWh in March 2016 to US cents 126.03/kWh in April 2016 by the EC's estimation based on the WEM concept contained in the Electricity Regulation, 2010, LI. 1937. In the Electricity Regulations, LI 1937 which is the governing statute for the Wholesale Electricity Market (WEM), the determination of the Spot Market Price (SMP) is based on the system marginal cost of supply which is the additional cost of producing one more unit in the national interconnected transmission system. In the event that the power system is facing capacity shortages, the system marginal capacity charge is added to the system marginal cost to arrive at the SMP. In effect, the SMP is an indication of the market-determined price of a kilowatt-hour of electricity generated in the period. Even though the WEM is not fully in place, the EC has been estimating the Spot Market Price (SMP) which it publishes in editions of this Bulletin. The SMP has been rising steadily from January 2016 (US cents 116.82/kWh), through February 2016 (US cents 124.34/kWh) to a high of US cents 132.98/kWh in March 2016 before dropping to US cents 126.03/kWh in April 2016. The drop in April 2016 is largely due to the over-drafting of the hydro power plants to make up for the loss in thermal power plants.

OPERATIONAL FACT SHEET

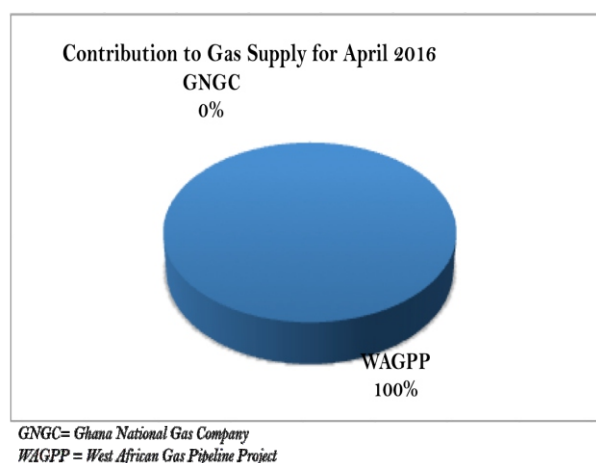
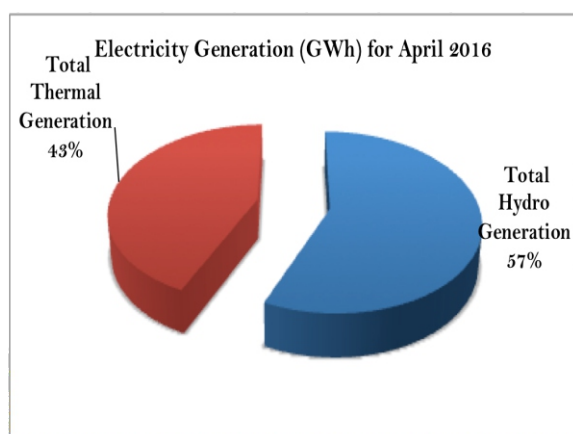
Peak Generation (MW) - April 2016						
Source of Supply	Week 1	Week 2	Week 3	Week 4	Maximum Non-Coincident Peak Generation	Generation at System Coincident Peak
Akosombo	753.0	737.0	727.0	704.0	753.0	702.0
Kpong	116.0	114.0	120.0	114.0	120.0	113.0
Bui	361.0	358.0	348.0	333.0	361.0	330.0
Sunon Asogli	46.2	88.0	88.4	132.7	132.7	88.3
TAPCO	-	41.0	146.0	149.0	149.0	146.0
TICO	301.0	312.0	318.0	164.0	318.0	314.0
TT1PP	-	-	-	-	-	-
CENIT	102.0	102.0	102.0	105.0	105.0	100.0
KTPP	-	-	102.0	105.0	105.0	-
TT2PP	19.9	12.0	12.6	30.8	30.8	6.1
MRP	-	-	-	20.3	20.3	-
AMERI Energy	-	-	-	-	-	-
Karpowership	220.0	219.9	220.0	219.0	220.0	219.7
Import	-	-	-	-	-	-
Trojan Power	-	-	-	-	-	-
Total Supply including imports	1,919.1	1,983.9	2,184.0	2,076.8	2,314.8	2,019.1
Total Generation without imports	1,919.1	1,983.9	2,184.0	2,076.8	2,314.8	2,019.1



Ghana Electricity Demand for April 2016		
Maximum Peak Generation	MW	2,019.10
Minimum Peak Generation	MW	1,679.60
Average Peak Generation	MW	1,841.95
Total Energy Generated	GWh	1,127.70
Load Factor (LF)	%	77.6%

OPERATIONAL FACT SHEET

Weekly Generation (GWh) - April 2016					
Power Plant	Week 1	Week 2	Week 3	Week 4	Total
Akosombo	100.46	91.04	89.23	116.95	397.68
Kpong	18.34	17.82	18.10	23.19	77.45
Bui	43.66	39.92	38.64	43.11	165.33
Sunon Asogli	6.89	9.51	8.85	19.22	44.47
TAPCO	-	0.90	17.17	30.92	48.99
TICO	34.60	50.32	42.03	33.57	160.52
TT1PP	-	-	-	-	-
CENIT	16.07	15.60	14.71	20.08	66.46
KTPP	-	-	1.32	8.25	9.57
TT2PP	1.24	1.88	2.01	2.20	7.33
MRP	-	-	-	-	-
AMERI Energy	-	-	-	-	-
Karpowership	36.06	36.19	35.58	42.07	149.90
Import	-	-	-	-	-
Trojan Power	-	-	-	-	-
Total Supply including imports	257.32	263.18	267.64	339.56	1,127.70
Total Generation without imports	257.32	263.18	267.64	339.56	1,127.70

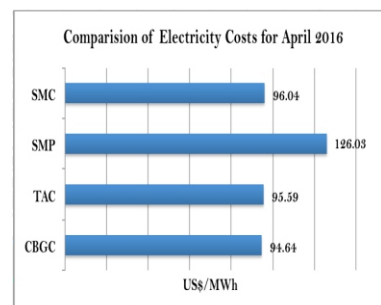


Average Gas Flow (mmscf) - April 2016					
Location	Week 1	Week 2	Week 3	Week 4	Monthly Average
Etoki	14.42	10.35	31.63	19.61	17.38
Tema	18.80	18.80	13.11	9.34	18.13
Aboadze	-	-	-	-	-

Water Level (ft) - April 2016					Change in water level
Hydro Dam	Week 1	Week 2	Week 3	Week 4	(feet)
Akosombo	238.82	238.47	238.18	237.55	(1.27)
Bui	565.05	562.32	559.90	554.39	(10.66)
Akosombo Minimum Design Operating Level	240.00	240.00	240.00	240.00	
Akosombo Maximum Level	278.00	278.00	278.00	278.00	

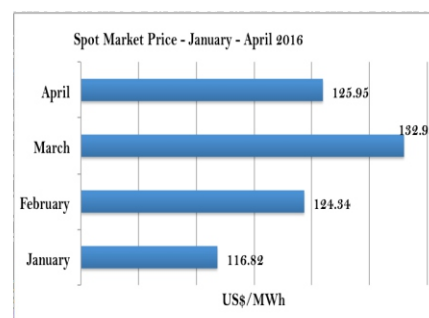
ECONOMIC FACT SHEET

Month at a Glance				
	Units	Current Month	Previous Month	Change
Average Market Energy Cost	US\$/MWh	75.88	69.02	6.86
Average Market Capacity Charge (AMCC)	US\$/MWh	19.71	23.19	(3.48)
Total Average Market Cost (TAC)	US\$/MWh	95.59	92.69	2.90
System Marginal Cost (SMC)	US\$/MWh	96.04	104.08	(8.04)
System Marginal Capacity Charge (SMCC)	US\$/MWh	29.99	28.89	1.10
Spot Market Price (SMP)	US\$/MWh	126.03	132.98	(6.95)
Composite Bulk Generation Charge (CBGC)	US\$/MWh	94.64	94.64	-
Deviation of TAC from CBGC	US\$/MWh	(0.95)	1.95	(2.90)
Deviation of SMP from CBGC	US\$/MWh	(1.39)	(8.34)	6.95



CBGC = Composite Bulk Generation Charge; SMC = System Marginal Cost; SMP = Spot Market Price

Power Plant	Maximum Non-Coincident Peak Generation (MW)	Plant Utilisation Factor (%)	Electricity Generation (GWh)	Gas Consumption (MMBTU)	LCO Consumption (MMBTU)	HFO Consumption (MMBTU)
Akosombo	753.00	70.98	397.68	-	-	-
Kpong	120.00	86.75	77.45	-	-	-
Simon Asogli	132.70	45.04	44.47	490,068.93	14,002.30	-
Bui	361.00	61.56	165.33	-	-	-
Trojan Power	-	-	-	-	-	-
TAPCO	149.00	44.19	48.99	-	423,204.52	-
TT1PP	-	-	-	-	-	-
TICO	318.00	67.85	160.52	-	1,230,119.34	-
MRP	20.30	-	-	-	-	-
CENIT	105.00	85.07	66.46	-	785,237.47	-
KTPP	105.00	12.25	9.57	117,525.77	-	-
TT2PP	30.80	31.99	7.33	21,551.23	63,026.40	-
AMERI Energy	-	-	-	-	-	-
Imports	-	-	-	-	-	-
Karpowership	220.00	92.00	149.90	-	-	1,242,846.38
Total	2,314.80		1,127.70	539,145.93	2,515,610.02	1,242,846.38



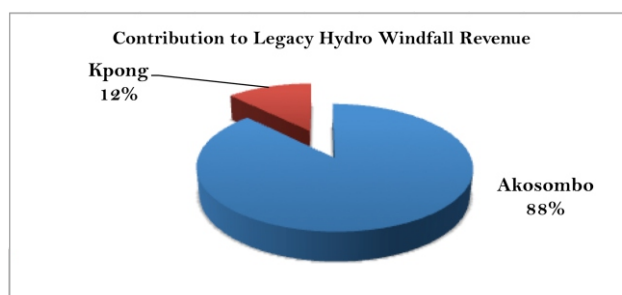
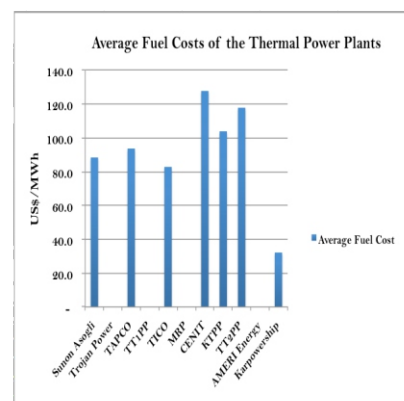
Spot Market Price = SRMC of Energy + SRMC of Capacity

		April 2016	March 2016	Change
Total Thermal Power Plants Fuel Cost	US\$	36,998,066.90	49,501,398.91	(12,503,332.01)
Average Thermal Power Plants Fuel Cost	US\$/MWh	75.93	73.86	2.07

Legacy Hydro Windfall Revenue for April 2016				
Power Plant	Average Cost (US\$/MWh)	Average SMP (US\$/MWh)	Difference (US\$/MWh)	Windfall Revenue (US\$)
Akosombo	33.10	125.95	92.85	36,926,127.15
Kpong	59.20	125.95	66.75	5,170,087.26
Total				42,096,214.40

SMP = Spot Market Price

Average Fuel Prices		
Fuel Type	Unit	Delivered Cost
Natural Gas	US\$/MMBTU	8.87
LCO	US\$/BBL	58.89
HFO	US\$/Tonne	174.85
DFO	US\$/Tonne	340.00



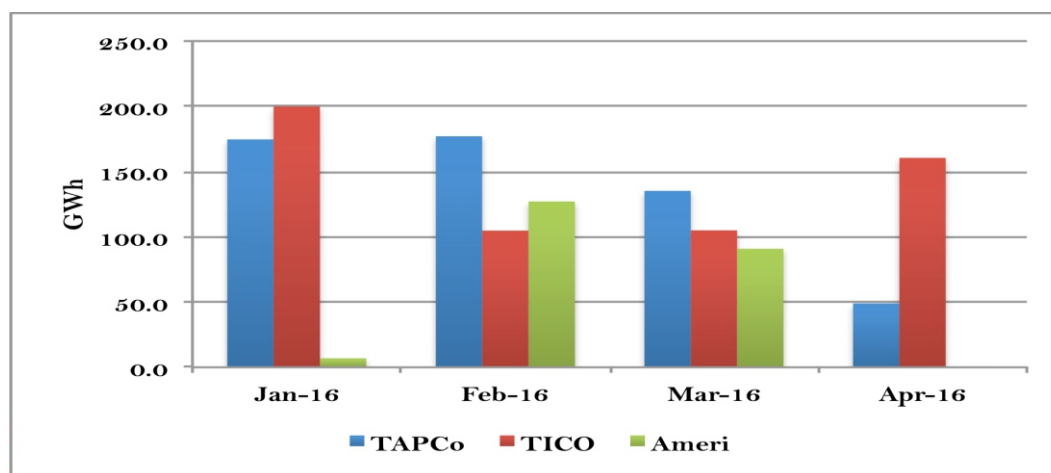
1. Prolonged shutdown of FPSO is costly to the economy

It is estimated that the shutdown of the Floating Production Storage and Off-loading facility (FPSO) in April 2016, which resulted in the curtailment of natural gas to the Aboadze Power Enclave, may have cost the economy over US\$ 30 million in April 2016 alone. The contributory factors to the loss to the economy have been identified as (i) revenue lost to the Ghana Gas Company, (ii) the cost of increased consumption of LCO by the thermal power plants (over 100,000 barrels) to compensate for reduced electricity generation from the Aboadze Power Enclave, (iii) payment of capacity charges to Ameri Energy Ltd under the Take-or-Pay contract even though it did not generate electricity, and (iv) the cost associated with increased drafting of the hydro power plants to produce an extra 200 GWh above the average electricity generated by the hydro power plants from January to March 2016. The cost of the over-drafting has been estimated using the “water value” concept. The “water value” has been approximated on the basis of the marginal cost of the Ghana power system using the economic merit-order dispatch methodology.

Natural gas supplies from the FPSO through the Ghana Gas Processing Plant has played a very important role in electricity generation since it became operational in December 2010 by supplying gas for the operation of thermal power plants in the Aboadze Power Enclave at Takoradi. Prior to the shutdown, from 1st January 2016 to 20th March 2016, natural gas supply from the FPSO/Ghana Gas Processing Plant to the Aboadze Power Enclave was, on the average, 91.2 mmscf per day. Indeed, domestic natural gas supplies from the FPSO have provided fuel security for the production of electricity given that natural gas supplies from Nigeria has been very unreliable. .

The FPSO was shut down for mandatory maintenance on 20th March 2016 and was scheduled to last for two weeks up to 4th April 2016. Unfortunately the maintenance schedule was prolonged owing to unforeseen technical difficulties. The prolonged maintenance led to extended curtailment of natural gas supplies from the Atuabo Gas Processing Plant resulting in the non-operation of a number of power plants in the Aboadze Power Enclave. The 250MW Ameri Plant, which is operated solely on natural gas, was shut down in April 2016 while the Takoradi Power Company (TAPCo) power plant and Takoradi International Company (TICO) power plant, both of which are operated on natural gas or LCO, were compelled to switch to LCO. Figure 1.1 shows electricity generated by the power plants within the Aboadze Power Enclave between January 2016 and April 2016.

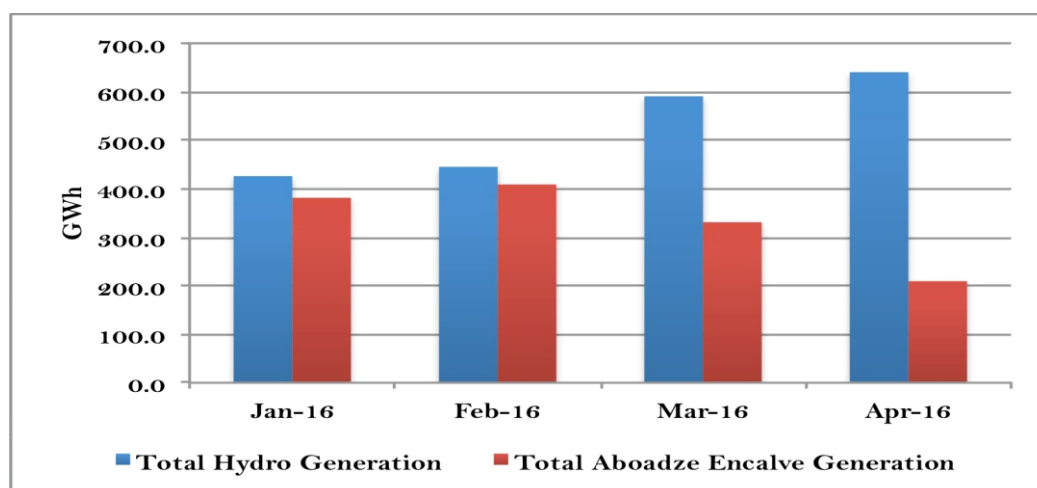
Figure 1.1. Electricity generation in the Aboadze Power Enclave – January 2016 to April 2016



Prior to the curtailment of natural gas supplies in April 2016, the Aboadze Power Enclave contributed significant amount of electricity to total requirements of the country. In January 2016, the thermal power plants in the Aboadze Power Enclave produced 381.486 GWh of electricity representing 33.99% of total electricity generated in the country. In February 2016, when the Ameri Energy Power Plant was fully operational, the thermal power plants in the Aboadze Power Enclave produced 408.9 GWh of electricity representing 36.8% of total electricity consumed in the country in that month. Indeed, it also represented 61.4% of all electricity produced from the thermal power plants in the country in February 2016. As a result of the shut down from 20th March 2016, electricity generation from the Aboadze Power Enclave reduced to 331.09 GWh in March 2016 from 408.9 GWh in February 2016. In April 2016, electricity generated from the Enclave was 209.5 GWh representing a reduction of 43.96% compared to the average generation from January 2016 to March 2016. In order to make up for the shortfall in generation from the Aboadze Enclave, total electricity generated from the hydro power plant -Akosombo, Bui and Kpong – was stepped-up to 640.43 GWh from 445.2 GWh and 590.76 GWh in February 2016 and March 2016 respectively. This represented an increase of 31.4% above the average electricity generated by the hydro power plants from January 2016 to April 2016. Figure 1.2 shows the growth in electricity generated from the hydro power plants in comparison with the decline in electricity generation from the Aboadze Power Enclave between January 2016 and April 2016.

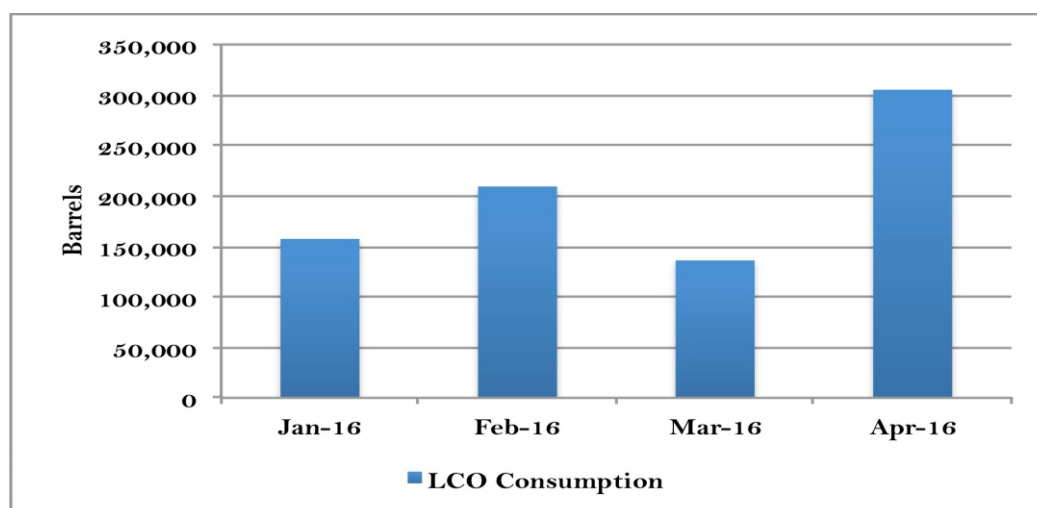
Other Market News and Trends

Figure 1.2



Switching of the power plants to run on LCO, in the absence of natural gas, comes with increased costs associated with higher maintenance requirements, LCO storage and management costs and higher price of LCO compared to natural gas. Consumption of LCO within the Aboadze Power Enclave rose significantly over the period January 2016 and April 2016. Figure 1.3 shows the monthly consumption of LCO from January 2016 to April 2016.

Figure 1.3. LCO consumption from January - April 2016



Between January 2016 and March 2016, LCO consumption by the power plants in the Aboadze Power Enclave was, on the average, 167,665 barrels per month. In April 2016 alone, when gas supply from Atuabo was curtailed throughout the month, LCO consumption by the power plants in the Aboadze Enclave shot up to 305,200 barrels representing an increase of 100,000 barrels or 59.7% higher than the average consumption from January 2016 to March 2016.

Using the estimated average cost of LCO delivered at Aboadze Power Enclave of US\$58.82/barrel for April 2016 and the increase in LCO consumption of 137,353 barrels, the cost of the delay in the maintenance of the FPSO in April 2016 alone is estimated at US\$ 8.0 million in LCO costs. The capacity charges due to Ameri Energy Ltd in April 2016 are estimated at US\$ 8.5 million. The capacity charges have to be paid even though the power plant did not generate any electricity because it is a requirement under the take-or-pay contract regime covering the procurement of the Ameri Energy power plant. The cost of over-drafting of the hydro power plants is estimated at US\$ 19.2 million. The amount is estimated based on the "water value" concept which is approximated as the system marginal cost (US cents 9.6/kWh) for the month of April 2016.

2. Security of supply of electricity is a “necessary evil”

Ensuring security of electricity supply is a priority objective in electricity markets and rightly so in the Ghana Wholesale Electricity Market. Meeting this objective is however a much more complex phenomenon than always taken to be, hence the obvious attendant consequences of electricity supply shortages or unintended load shedding. The complexity of security of supply arises from the fact that it is much more than just a statistical analyses exercise. Indeed, what makes it complex is the political sensitivity of achieving security of supply as no politician would want the lights to go out. Ironically security of supply should not be left in the hands of politicians especially as it pertains to increasing capacity additions. The irony is simply this: the cost of increasing electricity generating capacity to make up for meeting demand and reserves is paid for by the consumer and not any political groupings. Statistically, it is based on a definition of the number of hours per year that the market accepts supply curtailment. By this definition, the security-of-supply standards differ from market to market. The ideal situation is for zero loss of load expectation which is technically possible to attain but costly. Meeting the zero standard may mean over procurement well beyond what is techno-financially optimal. Generally security of supply can be met under various conditions: (i) attaining higher capacity reserves beyond load requirements; asking generators to go beyond their dependable capacity in some cases at the peril of the power plants as the case of the hydro power plants in Ghana have shown recently; (ii) voluntary reduction in demand by some consumers as pertains in other jurisdictions and (iii) cutting exports and increasing imports where prudently possible. Generally therefore, the more capacity is available, the lower the probability of the lights going out. However, achieving higher reserve capacity beyond peak load requirements is undeniably costly and has to be managed properly.

3. Features for Next Edition of the WEM Bulletin

The next (May 2016 Edition) of the Bulletin would be dedicated to developments in Solar Energy and Energy Demand Management in Ghana. Interesting news items for the Ghanaian electricity consumer in the face of the increases in electricity tariffs.

Acronyms

CSP	= Concentrated Solar Power	CBGC	= Composite Bulk Generation Charge (gazetted by the PURC)
EC	= Energy Commission	ECC	= Electricity Company of Ghana
EMOP	= Electricity Market Oversight Panel	HFO	= Heavy Fuel Oil
GoG	= Government of Ghana	GWh	= Giga-watt Hours
Ghp	= Ghana Pesewa	KTPP	= Kpone Thermal Power Plant
kWh	= Kilo-watt hours	LC	= Letter of Credit
LCO	= Light Crude Oil	LCOE	= Levelised Cost of Electricity
LI	= Legislative Instrument	LED	= Light Emitting Diode
MWh	= Mega-watt hours	MoP	= Ministry of Power
NITS	= National Interconnected Transmission System	PPA	= Power Purchase Agreement
PURC	= Public Utilities Regulatory Commission	PV	= Photovoltaic
WEM	= Wholesale Electricity Market		

For any enquiries please contact the:
EMOP Administrator, EMOP Secretariat, Energy Commission, Accra.
Telephone: +233-302813756/7/9; Or email: marketoversightpanel@energycom.gov.gh